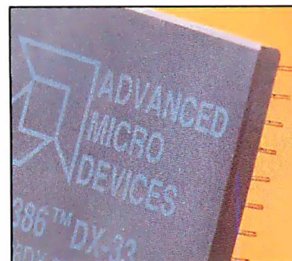
BYTE

A McGRAW-HILL PUBLICATION

AMD's Clone 386

Page 44



STATE OF THE ART

Network Management

Taming the Ill-Tempered LAN

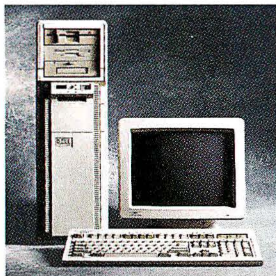
NETWORK BLUEPRINT

Undocumented DOS
Smart Memory Chips
Inside IDE Drives
N. Wirth's "Oberon"

Sony's Unix Portable
Winpro/3
Persuasion 2.0
SideKick 2.0
32-bit Ethernet Cards
DesignCAD Mac
Newtek's Video Toaster
The "Wallet-Friendly" Mac IIsi



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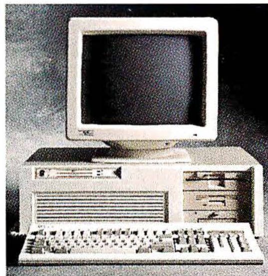
THE NEW DELL SYSTEM 425TE
25 MHz EISA i486.

- i486 microprocessor running at 25 MHz.

Commercial Lease Plan. Lease for as low as $278/month.

190 MB Super VGA Color System (800 x 600) $7,499

Price listed includes 4 MB of RAM.* 80, 100, 330 and 650 MB hard drive configurations also available.



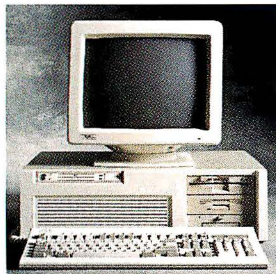
THE DELL SYSTEM 320LX
20 MHz 386SX.

- Intel 80386SX microprocessor running at 20 MHz.

Commercial Lease Plan. Lease for as low as $104/month.

40 MB VGA Color Plus System $2,799

Price listed includes 1 MB of RAM.* 80, 100, 190, 330 and 650 MB hard drive configurations also available.



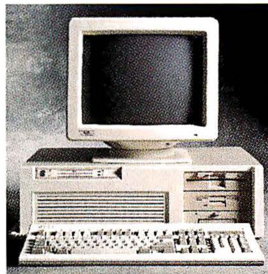
THE DELL SYSTEM 433E
33 MHz EISA i486.

- i486 microprocessor running at 33 MHz.

Commercial Lease Plan. Lease for as low as $307/month.

100 MB Super VGA Color System (800 x 600) $8,499

Price listed includes 4 MB of RAM.* 80, 190, 330 and 650 MB hard drive configurations also available.



THE DELL SYSTEM 425E™
25 MHz EISA i486.

- i486 microprocessor running at 25 MHz.

Commercial Lease Plan. Lease for as low as $235/month.

100 MB Super VGA Color System (800 x 600) $6,499

Price listed includes 4 MB of RAM.* 80, 190, 330 and 650 MB hard drive configurations also available.



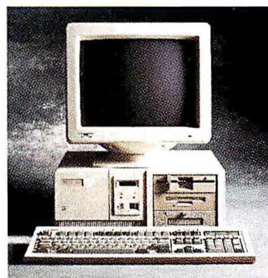
THE NEW DELL SYSTEM 333D
33 MHz 386.

- Intel 80386 microprocessor running at 33 MHz.

Commercial Lease Plan. Lease for as low as $131/month.

40 MB VGA Color Plus System $3,599

Price listed includes 1 MB of RAM. 80, 100, 190, 330 and 650 MB hard drive configurations also available.



THE NEW DELL SYSTEM 325D
25 MHz 386.™

- Intel 80386 microprocessor running at 25 MHz with 32 KB external cache.

Commercial Lease Plan. Lease for as low as $112/month.

40 MB VGA Color Plus System $2,999

Price listed includes 1 MB of RAM.* 80, 100, 190, 330 and 650 MB hard drive configurations also available.



THE DELL SYSTEM 316SX
16 MHz 386SX.

- Intel 80386SX microprocessor running at 16 MHz.

Commercial Lease Plan. Lease for as low as $79/month.

40 MB VGA Color Plus System $2,099

Price listed includes 1 MB of RAM.* 20, 80, 100 and 190 MB hard drive configurations also available.



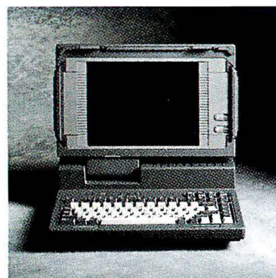
THE DELL SYSTEM 210
12.5 MHz 286.

- 80286 microprocessor running at 12.5 MHz.

Commercial Lease Plan. Lease for as low as $59/month.

20 MB VGA Monochrome System $1,549

Price listed includes 1 MB of RAM.* 20, 80 and 100 MB hard drive configurations also available.



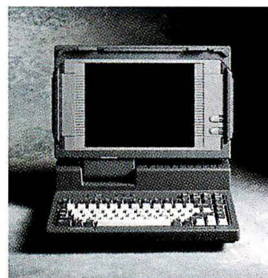
THE NEW DELL SYSTEM 320LT
20 MHz 386SX.

- Intel 80386SX microprocessor running at 20 MHz.

Commercial Lease Plan. Lease for as low as $131/month.

20 MB, 1 MB RAM.* $3,599

40 MB hard drive configurations also available.



THE DELL SYSTEM 316LT
16 MHz 386SX.

- Intel 80386SX microprocessor running at 16 MHz.

Commercial Lease Plan. Lease for as low as $112/month.

20 MB, 1 MB RAM.* $2,999

40 MB hard drive configurations also available.

The Dell System 433TE and 425TE are class A devices sold for use in commercial environments only. *Performance Enhancements: Within the first megabyte of memory, 128 KB (316SX, 320LT, 316LT and 210) 96 KB (333D and 325D) or 384 KB (320LX, 425E, 433E, 425TE and 433TE) of memory is reserved for use by the system to enhance performance. Can be optionally disabled on 333D, 325D, 316SX and 210. All systems are photographed with optional extras. All prices and specifications are subject to change without notice. Dell cannot be responsible for errors in typography or photography. †Source: Compaq Computer Corporation price list effective 10/15/90. Actual dealer prices may vary. **Payment based on 36-month, open-end lease. Leasing arranged by Leasing Group, Inc. In Canada, configurations and prices may vary. Dell and DELL SYSTEM are registered trademarks, 425E and SmartVu are trademarks of Dell Computer Corporation. Intel is a registered trademark and 386, 486, and i486 are trademarks of Intel Corporation. Other trademarks and trade names are used to identify the entities claiming the marks and names or their products. Dell Computer Corporation disclaims any proprietary interest in trademarks and trade names other than its own. On-site service may not be available in certain remote locations. Shipping, handling and applicable sales tax not included in the price. For information on and a copy of Dell's 30-day Total Satisfaction Guarantee, limited warranty, and Xerox's Service Contract, please write to Dell USA Corporation, 9505 Arboretum Boulevard, Austin, Texas 78759-7299, ATTN: Warranty.

APPEALING.

Shelling out an extra $10,000 for a Compaq SystemPro with chancey service is appalling. With that kind of iffy support, they should be paying *you* the ten grand.

On the other hand, Dell's i486™ servers come with the same service that's won an unprecedented 8 *PC Week* Corporate Satisfaction Polls for PCs, laptops and servers.

Spend less. Get more. Sounds better, doesn't it?

We have two new i486 EISA servers.

Dell gives you a choice of the 25 MHz Dell® 425TE and the 33 MHz Dell 433TE.

The 25 MHz Dell System® 425TE has up to 64 MB of RAM capacity, 11 storage bays, and a whisper-quiet 300 watt power supply. We've also built in features such as password protection, a software controlled reset switch, and an efficient cooling system to protect component life.

TO ORDER, CALL
800-365-1240
HOURS: 7 AM-9 PM CT M-F 8 AM-4 PM CT SAT.

In Canada 800-387-5752. In the U.K. 0800 414535. In France (1) 30.60.68.00. In Germany 06103/701-0. In Sweden 0760-713 50.

What's more, both the 433TE and the 425TE have the Dell designed SmartVu™ diagnostic display built in. This ingenious innovation helps identify problems even if the monitor goes down.

For even more performance, the 33 MHz Dell System 433TE is everything our 425TE is, with 32% more speed. The Dell exclusive memory design with a 128 KB external cache gives it maximum throughput.



From this foundation, create a powerful PC network or UNIX® workgroup. Dell's new systems have more than enough performance to function as a LAN server and WAN or internetworking gateway. So they're capable of supporting the most demanding server use—a multi-function network. Of course, they're compatible with all major networks, including Novell, 3COM, Banyan and LAN Manager.

HERE'S OUR NEW STORE, SO YOU'LL NEVER HAVE TO GO TO THEIR STORE AGAIN.

When you buy a computer from a typical computer store, here's what you get:

A beefy retail mark-up.

Pressure to buy things you don't want.

That crummy feeling of not knowing what you're getting, because the salesman isn't sure what he's selling.

And, when there's a problem, some guy with a screwdriver taking your computer apart.

When you call Dell, on the other hand, here's what you get:

A frank talk with computer experts about what you need, and a recommendation about the best overall package for you.

Custom configuration, with options including monitors, memory sizes, software, accessories and peripherals.

Service — consistently voted the best in the industry — by computer experts who know our computers inside and out.

A variety of financing and leasing◊ options.

A firm promise to perform a fully configured systems test, and ship by two-day air standard.

A 30-day, no questions asked, money back guarantee.

A one-year limited warranty.

And a great price.

Call us now. Why waste a trip when everything you need is right in front of you?



THE NEW DELL SYSTEM® 433TE 33 MHz i486.

STANDARD FEATURES:

• Intel® i486 microprocessor running at 33 MHz with 128 KB external cache. • Standard 4 MB of RAM,* expandable to 64 MB (eight internal SIMM sockets, each accepting a 1 MB, 2 MB, 4 MB or 8 MB SIMM, installable in matched pairs). • Socket for WEITEK 4167 math coprocessor. • 11 internal half-height drive bays. • Eight 32-bit EISA expansion slots (six EISA master slots and two EISA slave slots). • High-performance IDE (80 MB, 100 MB, 190 MB) and ESDI (330 MB, 650 MB) hard disk drives.

650 MB VGA Color Plus System Using 4 MB SIMMS.

Price listed include 8 MB of RAM.

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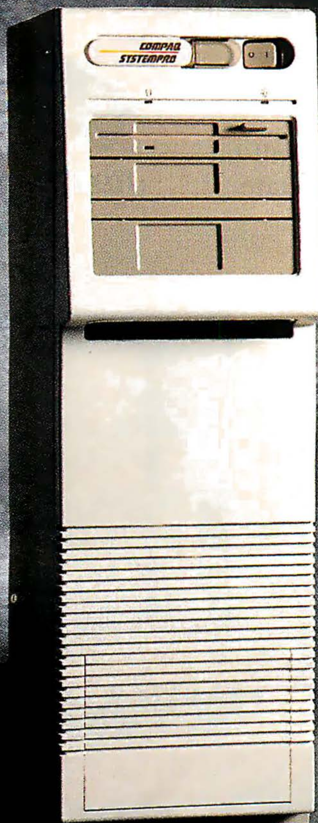
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In Canada 800-387-5752. In the U.K. 0800 414535. In France (1) 30.60.68.00. In Germany 06103/701-0. In Sweden 0760-713 50.

APPALLING.



Maintaining servers is beyond most computer repairmen. If a server goes down, your whole company can go down with it.

Would you trust some unknown technician to bring it back up? We wouldn't.

That's why we have a special advanced systems hotline so you can call us direct. Dell is an AT&T UNIX source code licensee and an authorized Novell Network Reseller.

So our technicians are more than Dell experts, they're Networking experts.

On those rare occasions we can't fix it over the phone, Xerox^ technicians will come to your office with the solution in hand.

Or, say you're pulling an all-nighter and need help. Dell has pioneered a service called TechFax. Any time. 24-hours a day, you can pick up the phone and call the Dell technical support library on the automated TechFax line to get information on your Dell server faxed right back to you.

There's a lot to know before you buy a server.

When you call Dell, our experts will give you the help you need to buy an advanced PC or UNIX server.

Then we'll send it off with a 30-day no questions asked money back guarantee, and a one year limited warranty.

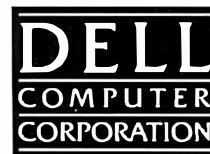
So call us.

Unless you find appalling appealing.

The 425TE and 433TE are perfect for UNIX workgroups, supporting either character-based, multi-user or graphical-based client/server environments.

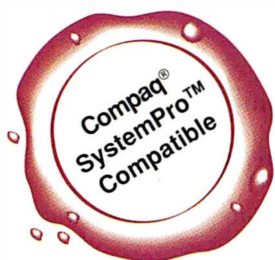
You can buy Dell servers preloaded with UNIX System V, making them literally plug and play.

Even more impressive is the fact that UNIX system administration can be done by Dell, remotely.



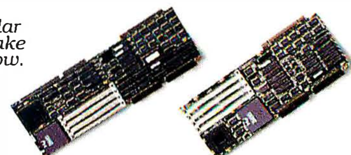
Circle 89 on Inquiry Card.

There's An Double Your



Introducing The ALR POWERPRO



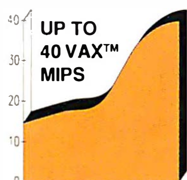


With the POWERPRO's advanced modular system architecture, the choices you make today won't limit your options tommorrow.

Just Upgrade the CPU!™

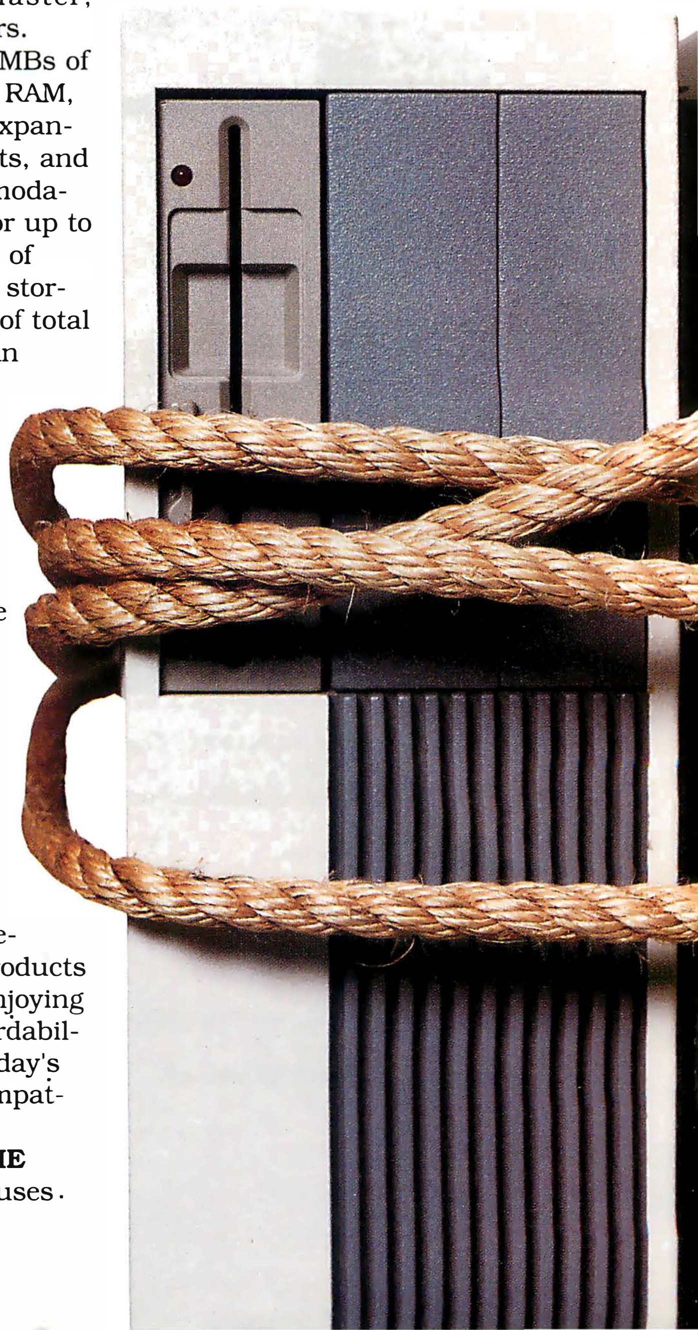
Strapping two traditional PCs together won't give you the dual processing power you need to keep pace with today's growing networks and multi-user environments, but the new ALR®POWERPRO will. It's the affordable, high-performance alternative to the COMPAQ® SYSTEMPRO™.

Whether you need a system for single or multiple users, CAD/CAM, office automation, manufacturing management systems, shared databases or a host of other applications, there's a POWERPRO that delivers. Choose between one or two 33–MHZ i486 processors and up to 1–MB of cache for performance ranging from 14.7 to 40 VAX™ MIPS. Single CPU models can be quickly and easily upgraded to dual processing.



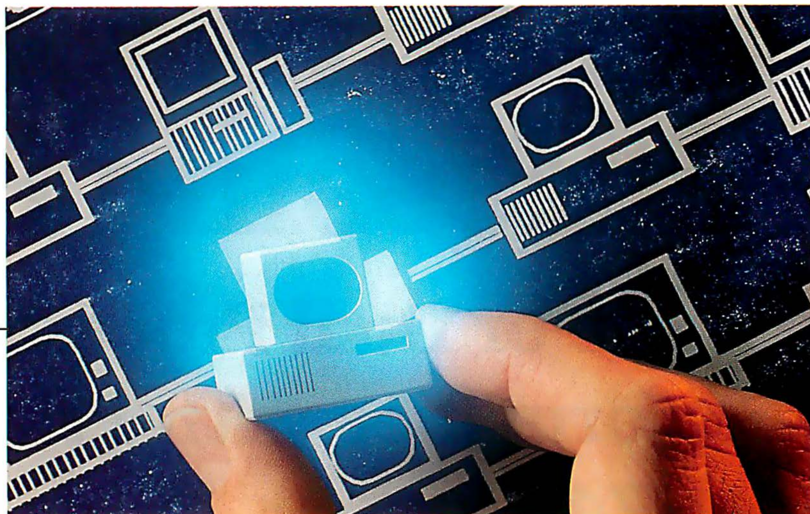
Additionally, all models will be able to accommodate future, faster, processors. With 49-MBs of possible RAM, twelve expansion slots, and accommodations for up to 2.5-GB of internal storage (up to 10-GB of total storage utilizing an external ALR expansion chassis), the POWERPRO has the expandability needed to keep pace with your future needs. The POWERPRO also incorporates a 32-bit EISA bus, so you'll have maximum compatibility with cutting-edge enhancement products while enjoying the affordability of today's low-cost "AT" compatible hardware.

SUPERIOR CACHE
The POWERPRO uses ALR's proprietary



BYTE

March 1991 *Volume 16, Number 3*



COVER STORY

STATE OF THE ART

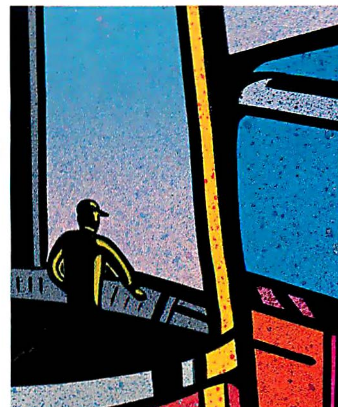
Network Management

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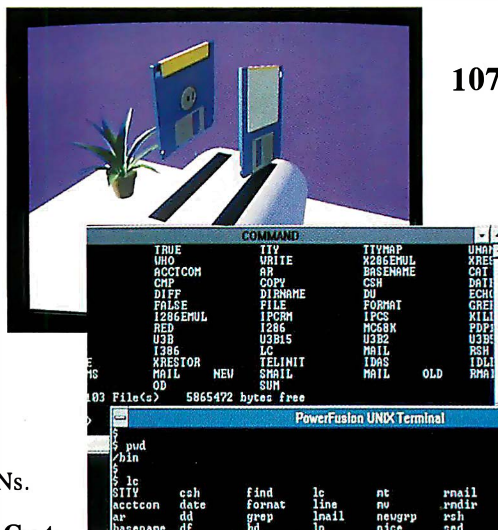
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STATE OF THE ART



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OPINIONS

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BYTE (ISSN 0360-5280/91) is published monthly with an additional issue in October by McGraw-Hill, Inc. U.S. subscriber rate $29.95 per year. In Canada and Mexico, $34.95 per year. Single copies $3.50 in the U.S., $4.50 in Canada. Executive, Editorial, Circulation, and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Printed in the United States of America. **Postmaster:** Send address changes, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520.

The Joneses.



Check out the benchmarks. When it comes to speed, pure and simple, mainframes are no longer the main attraction.

Introducing the Everex STEP 486/33 and STEP 486/25. Along with the STEP 486*is*, they give you desktop performance that was previously unheard of.

STEP 486/33	34,000 Dhrystones (19.4 MIPS)
CRAY-X-MP/48	17,857 Dhrystones
IBM 3083	16,666 Dhrystones

There are two reasons. The first, of course, is the 486™ chip. The other is AMMA,™ Everex's proprietary Advanced Memory Management Architecture.

AMMA uses "write-back" cache technology instead of the "write-through" technologies used in most PC's. The write-back cache was developed for mainframes. Everex was the pioneer in developing it for the PC. And in doing so, opened a whole new dimension in desktop performance.

With AMMA, you can write directly to the STEP 486's cache in nearly all cases. With write-through techniques, on the other hand, you lose most of the performance benefit of the cache.

*Inquiries from outside the U.S. call 415-498-1111. EVER for EXcellence is a registered trademark and Everex, STEP, STEP 486*is*, AMMA and PDS are trademarks of Everex Systems, Inc. 486 is a trademark of Intel Corp.

BYTE Topic Index and Author Guide

This index, combined with the table of contents (page 4) and the Editorial Index by Company (page 376), will let you identify articles by type, subject, title, author, or product discussed.

Starting next month, the Joneses will look like Larry, Moe and Curly.

Stay tuned.

And how to keep up with them.



That's because write-through forces you to write to main memory much more often. And main memory is slower than the cache.

This is especially important in 486 computing, where the CPU performs as many as four times the write operations as in 386. Which makes AMMA's write-back architecture, combined with the 486's embedded cache, a powerful combination indeed.

But the STEP 486 machines give you more than just speed. They come with Programmable Drive Select. If your drive isn't listed on the set-up table, PDS™ lets you custom-configure the BIOS. It's good for virtually any hard drive.

What's more, all STEP systems come with a one-year extendable warranty and a one year renewable on-site service contract that also covers all Everex peripherals in the system.

To find out more, call 1-800-334-4552* for the name of your nearest Authorized Everex Reseller—every one a high performance expert.

Then you can let the Joneses try keeping up for a change.



BYTE

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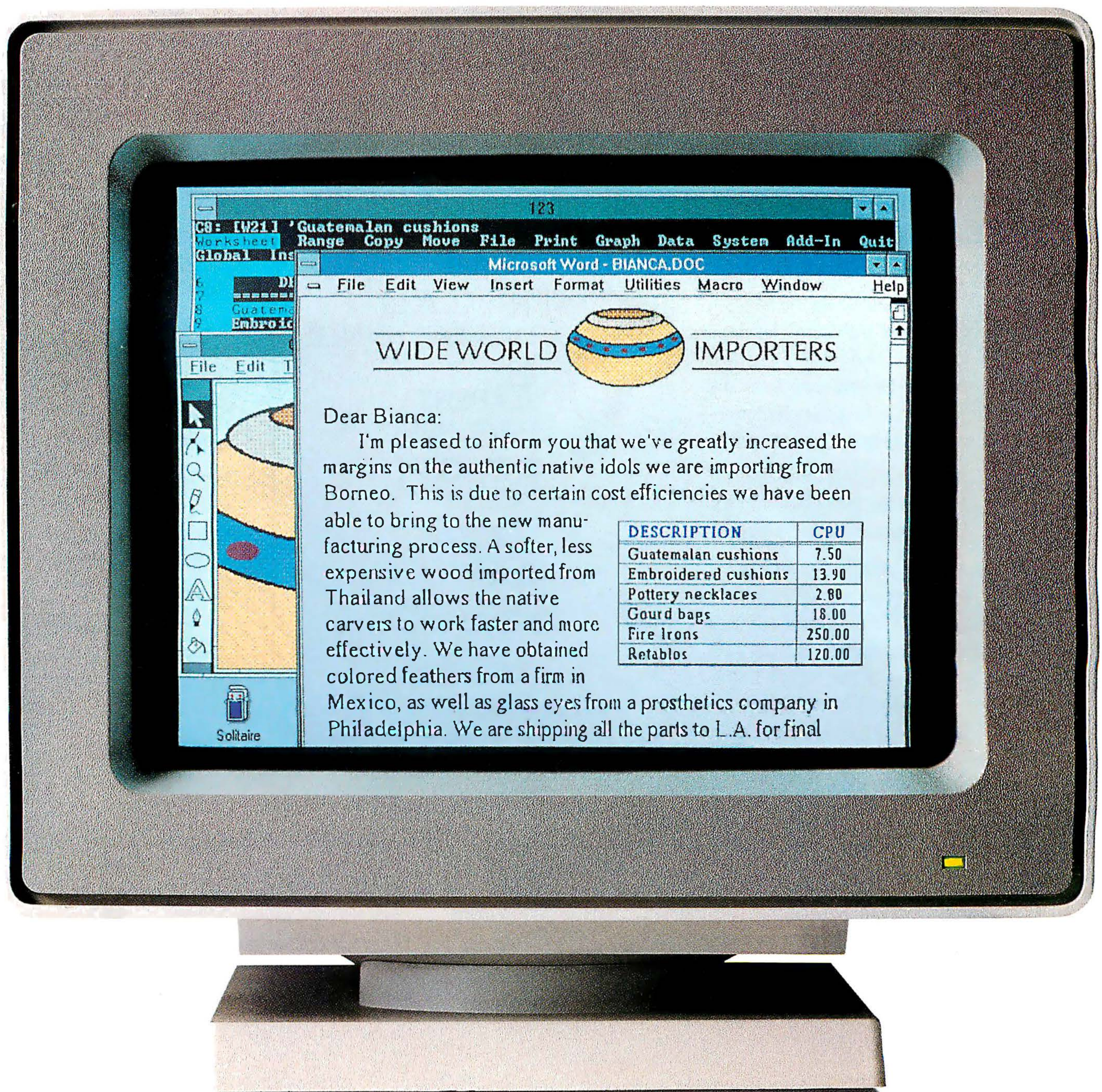
Founder: James H. McGraw (1860–1948).



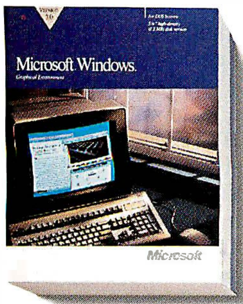


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The perfect en
the lazy and p



vironment for
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The Microsoft® Windows™ graphical environment version 3.0 makes it easy for you to do a lot more with your PC. That's because the Windows environment has friendly icons, menus and dialog boxes that make its powerful features very accessible.

Windows lets you work with a variety of applications on-screen at the same time. Including your character-based programs.

But it's when you start using Windows applications that you get the most out of your PC. Windows applications are easy. In addition they all work essentially the same *way*. So once you learn how to use one, you generally know how to use them all.

And they're so intuitive that experimenting with them is fun.

Windows applications let you cut and paste text and graphics. And let you combine them right on your screen. They also let you print out exactly what you see.

You can even establish links between Windows applications. Which means, if you change any numbers in Microsoft Excel for Windows, the chart you cut and pasted into your Microsoft Word for Windows document will be automatically updated.

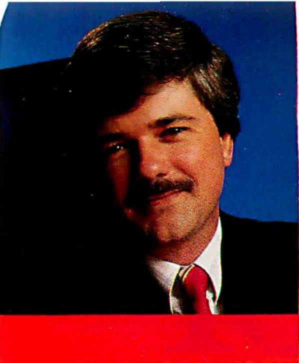
So call us at (800) 541-1261, Department P31, to find out more about Windows, Windows applications or the big Windows World Convention and Exposition coming up May 20th and 23rd in Atlanta.

Because with Windows, you can start taking the work you do every day a little easier.

And have more to show for it.

Microsoft®
Making it all make sense™

For more information, call (800) 541-1261, Dept. P31. In Canada, call (416) 568-3503. Outside the U.S. and Canada, call (206) 936-8661.



EDITORIAL

FRED LANGA

OF HARD DISKS AND REDESIGNS

BYTE is a little different this month.

Here's how, and why.

It's an annual ritual. Perhaps not quite as colorful as waiting to see if a groundhog sees its shadow, and certainly not as festive as a First Night celebration. In fact, it sounds downright mundane. Early in each new year, I spend the better part of a day thoroughly reorganizing the files on my hard disk drive.

Inevitably, and despite regular small housecleanings, I'll discover several subdirectories that I don't need anymore, several others that would be better in a different location in the directory tree, and a few holes where I should have created subdirectories but didn't. Sometimes, the changes are minor; other times, major.

You've probably done the same sort of disk housekeeping from time to time. It's a hassle, but when it's done, what a pleasure. You can *find* everything. The disk organization makes sense. Your work is more streamlined and efficient.

This year's hard disk drive reorganizing paralleled a larger and more important event that's happening with BYTE, but one that serves exactly the same purpose. As you may already have noticed, we've reorganized the magazine. The goal was simple: to give you something better than before, something that will let you use BYTE more efficiently. Just as you'd do with your own information, we've reordered sections of BYTE so that like articles are grouped together and you can quickly find exactly the kind of information you're looking for.

For example, all late-breaking items within BYTE—the award-winning Microbytes pages, an expanded First Impression section, and the popular What's New section—are now grouped together under a single section title: News.

Jerry Pournelle, Wayne Rash, Stop Bit, Print Queue, and Letters are logically grouped under Opinions. We've also added a unique new column called Roundtable. You'll find some of BYTE's most topical writing and colorful commentary in the Opinions pages.

BYTE is one of the very few computer magazines to offer true feature articles, and it's the only one to devote 30 to 50 pages each month exploring important, forward-looking state-of-the-art technologies. So, we have grouped the Features and State of the Art sections and run them back to back after Opinions.

But state-of-the-art information is only half the story, because no computer technology is worth a damn unless you can put it on your desk and use it. So, the State of the Art section flows smoothly into our "state-of-the-market" section: the reviews. Here, the BYTE Lab continues doing what BYTE has done best since 1975, bringing you unbiased, objective product analysis across all the major operating platforms. Combined, these sections deliver a one-two combination that will not only arm you with the information you need to make informed buying decisions today, but also prepare you for the decisions you'll have to make tomorrow.

A new Hands On section rounds out the book. In this section, the popular Under the Hood will continue to help you understand the technologies embedded in today's shipping products, with its usual emphasis on hardware; Some Assembly Required follows a similar tack, but it emphasizes software.

In the Hands On section, you'll also read the expert advice, recommendations, and operating tips of a number of regular and guest columnists. This platform- or issue-specific information is the nuts and bolts of BYTE, where you can learn how to optimally use the technologies and products discussed elsewhere in the magazine.

By itself, this reordering of the information within BYTE would have been good. But each issue still contains many hundreds of pages, and it still can take a while to find what you're looking for. To help you make the most of your reading time, we've added two new tools. First, throughout the magazine, you'll see Action Summaries that will give you, at a glance, the highlights of each article and review. Second, we've added a Topic Index and Author Guide immediately after the table of contents. It provides a wealth of detail to supplement the table of contents so you can easily find exactly those subjects you're most interested in.

These changes don't stand alone: They're complemented by a new graphical look for BYTE that's brighter, easier to read, and "cleaner." And we've paid special attention to eye relief and clarity of layout, so the time you spend with BYTE will be as pleasant and enjoyable as possible.

We hope you'll like the changes. Drop me a note and let me know what you think!

—Fred Langa
Editor in Chief
(BIX name "flanga")

Don't miss the Borland Languages Conference.
April 28 through May 1, 1991, San Francisco, CA. For information, call 1-800-942-TURBO

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LETTERS

Relational Realities

Steven J. Vaughan-Nichols presents an excellent and balanced summary of the advantages of relational DBMS products in "Relational Databases: The Real Story" (December 1990). I would like to offer one small addition. We have been consultants and contract programmers in the PC database industry for 10 years. None of our clients has ever asked whether the DBMS we used to solve their problem was relational. Many of them would probably not even understand the issue. What they all have in common is some problem that needs solving. We give them solutions, not theory.

Tony Lima, President
Pacific System Design Workshop, Inc.
San Carlos, CA



I was surprised by Steven J. Vaughan-Nichols's emphasis on null value support in his "Relational Databases: The Real Story." While null value support is an important relational DBMS function, it has been relatively easy to implement once the requirement has been recognized and, in fact, is available in many DBMS products. (Null value support is the ability to distinguish between an unknown value and a value of 0 or blank character fields.) Edgar Codd recognized that null value support is difficult to implement at the application level but relatively simple to implement at the DBMS level. Since his popularization of the notion, many DBMS products, including several that are not based on the relational models, have provided this function.

Vaughan-Nichols also suggests that he would like to see greater consistency in processing null values. It seems to me that it is the job of the DBMS to provide a consistent method for representing nulls in the database but that handling these values must remain at the application level so that they can be appropriately manipulated, depending on the individual application or purpose.

Hedy Alban
Cherry Hill, NJ

Nulls in relational database theory are like the quicksilver flash of sunlight on water—easy to describe in general, nigh onto impossible to capture in detail. While many DBMSes do indeed implement nulls at the DBMS level, no DBMS I know of handles nulls in a systematic fashion. Moreover, some DBMSes that are consistent in representing nulls misdefine them at the application level. Even DBMSes that do represent nulls consistently and correctly are inconsistent in handling them. In relational DBMS theory, to paraphrase Codd, nulls are not just a representation issue. Null handling is an issue for the DBMS as well as for the application level.

There is, indeed, still a need for greater consistency in both representing and handling nulls. Space considerations do not permit a full discussion of these matters here. Interested readers are directed to Edgar Codd's The Relational Model for Database Management *(Addison-Wesley, 1989) for a complete discussion of these issues.*—Steven J. Vaughan-Nichols

WE WANT TO HEAR FROM YOU. *Please double-space your letter on one side of the page and include your name and address. Letters two pages in length or under have a better chance of being published in their entirety. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. You can also send letters via BIXmail c/o "editors."*

Your letter will be read, but because of the large volume of mail we receive, we cannot guarantee publication. We also reserve the right to edit letters. It takes about four months from the time we receive a letter until we publish it.

Give Macs Their Due

I read and appreciate BYTE for its informative, high-quality articles, but I was disappointed by David Fiedler's The Unix /bin: "Back to the Workstations II" (December 1990).

Obviously a Macintosh hacker, Fiedler makes it a point to try to impress us with the Mac's capabilities. He falls short, though, of impressing anyone who knows much about networking, Macs, PCs, or workstations. I manage over 100 Suns, Macs, and PCs, and I can assure you that Unix and DOS networking is at least a generation ahead of Mac networking capabilities. This is especially true with regard to security and availability of software, not to mention backup, network management, mail gateways, routers, and wide-area capabilities.

I have to complain about this Mac grandstanding. Please don't insult knowledgeable readers by straying from your high standards of technical journalism.

Roger Marquis
Berkeley, CA

I have to laugh at the assertion that I am "obviously a Macintosh hacker." I do not own a Mac or even use one. In fact, I have been journalist non grata at Apple ever since I lambasted its A/UX 1.0 in print. However, I do give credit where credit is due. A/UX 2.0 is much improved, and Macs do tend to network rather easily (at least among themselves). Compare, say, setting up UUCP on almost any Unix machine to hooking up a number of Macs to a laser printer. While the capabilities of PC LANs are not in question, in general it is far simpler to hook up and deal with Macs.

Concerning Unix, my subject of expertise: Of course Unix LANs are more powerful than Mac LANs. But with that power, you also get complexity (although, in general, Unix LANs give a great deal of flexibility for a bit more work than most PC LANs, be they ISA or Mac). I personally run Unix on 386 PC hardware and am quite familiar with all the interrupt vectors, addressing, and other problems that must be solved each time the system configuration is changed. Perhaps your system has standardized each Sun, Mac, and PC so that adding new ones is simple. But if you have to deal with a completely heterogeneous environment, you might find that things can get quite complex.—David Fiedler

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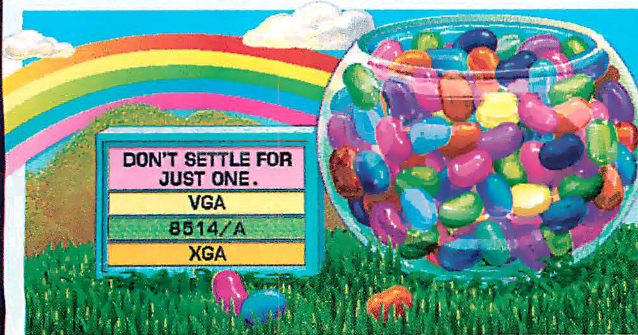
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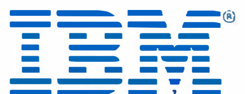
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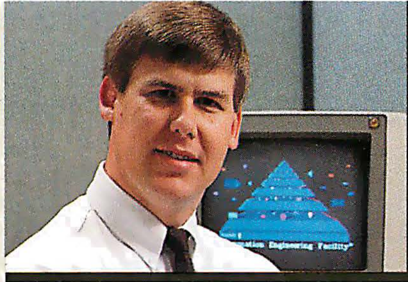
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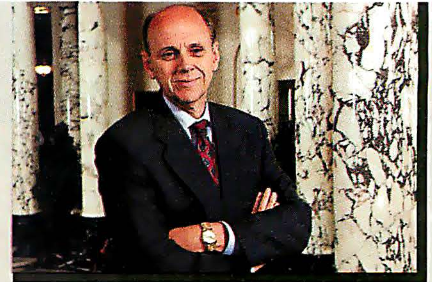
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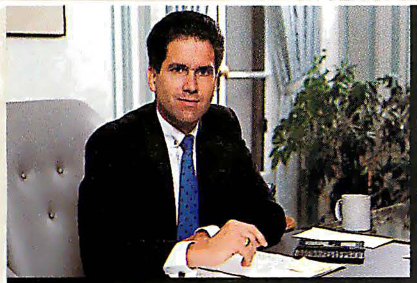
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"The strengths of the IEF are clear-cut. One obvious quality advantage is that application changes are made to diagrams, not code. This ensures ongoing integrity—the specification always matches the executing system."

Paul R. Hessinger
Chief Technology Officer
Computer Task Group



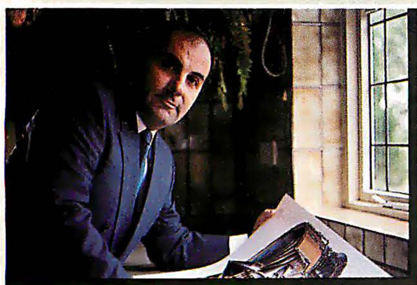
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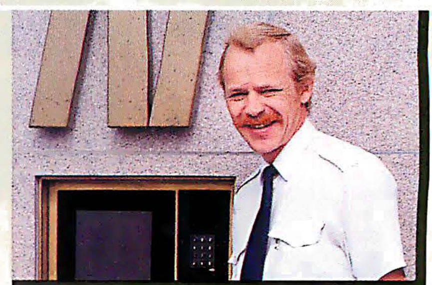
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Cloene Goldsborough
Director of Data Resource Management
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Mogens Sorensen
Chief Consultant
Nykredit (Denmark)

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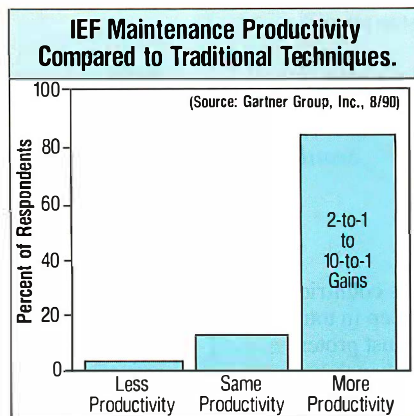
The quality of IEF-developed systems is remarkable. In recent CASE research by The Gartner Group, application developers were asked to report the number of abends they had experienced. (An "abend" is a system failure or "lock-up" caused by code defects.) IEF *developers reported zero defects—not one abend had occurred in IEF-generated code.*

Maintenance productivity gains of up to 10-to-1.

In this same study, developers were asked to compare IEF maintenance productivity with their former methods. Of those responding, *more than 80 percent had experienced gains of from 2-to-1 to 10-to-1.* (See chart.)

Specifications always match the executing application.

With the IEF, application changes are made to diagrams, not code. So, for the life of your system, specifications will always match the executing application. The Gartner Group research showed that *all* IEF users who reported making application changes made *all* changes at the diagram level.



Developers were asked to compare IEF maintenance to former methods. Of those responding, more than 80% reported productivity gains of from 2-to-1 to 10-to-1.

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IEF tools and IEF-generated code will comply with standards as they emerge. We will adhere to CUA standards and to the principles of IBM's AD/Cycle and DEC's COHESION—and we will support Open Systems environments centering around UNIX. In any environment, the COBOL, C and SQL we generate adhere closely to ANSI standards. Our presence on standards committees helps us keep abreast of ANSI and ISO developments affecting the CASE world.

Full-service support.

Of course, our technical support, consultancy, training courses, satellite seminars, and other informational assistance will continue apace. We also offer re-engineering and template services. This full-service support will remain an integral part of the IEF product.

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TEXAS INSTRUMENTS

Software Quality Control

Hear! Hear! to Brett Glass's "A Plea for Software That Works" (Stop Bit, December 1990). As computers get more powerful and as programs get more complex, it is imperative that software developers do a better job of quality control. One of my pet peeves is the lack of meaningful software warranties. Manufacturers routinely disclaim any responsibility for whether their programs work or not. It would be much more encouraging if they would simply say, "If there are problems, let us know and we will fix them." That, at least, would indicate some good faith and would be a step toward a maturing of the computer industry.

So in addition to software that works, let's have software companies that work.

Michael Hanson
Seattle, WA

For Comparisons Only

Over the years, I have worked in various countries and use your excellent periodical to keep in touch with the latest developments. However, I must protest what I consider one of the most misleading benchmark comparisons ever published ("LAN Manager 2.0: A Force to Be Reckoned With," December 1990). The benchmark in question sought to compare LAN Manager with NetWare 386 and NetWare 286. My R&D staff was at first astonished at the difference between NetWare 386 and NetWare 286.

We then noticed that whereas NetWare 386 used a Systempro as a file server, NetWare 286 ran on an 8-MHz 286 AT clone. To add insult to injury, even the network interface cards were different. The difference in performance is almost entirely due to the difference in hardware. Please remind the author that when testing software, the hardware should be identical; otherwise only guesses, not deductions, can be made.

M. Thomas
Executive Head of Information Technology
Bank of Valletta, Ltd.
Valletta, Malta

The primary comparison was between LAN Manager 2.0 and NetWare 386. These are functionally comparable network operating systems, which I ran on identical hardware—the NE3200-equipped Systempro. I used the NetWare 286/16-bit network interface card system in the same spirit that the BYTE Lab uses a standard AT in its system benchmarks: as a baseline point of reference. While it's interesting to read about Porsches, a lot of us actually drive Fords. Clearly, the 386/32-bit network interface card will outrun the 286/16-bit network interface card, software notwithstanding; I included the latter results only to provide perspective. I apologize for not specifying my intent more clearly.—Jon Udell

Wilted Lattice?

How could you possibly have published "One-Size-Fits-All Code with Lattice C" in your November 1990 issue? Lattice is out of the compiler business. Sure, you can buy version 6.0, and the company supports it at this point, but that's the end of the road. Anyone who builds a development activity around Lattice C today is going to have to convert tomorrow, and although we thought 6.0 was a good step in the right direction, it was too little too late.

I think you ought to square this away somehow with your readers because a lot of newcomers to C will see the low price for this giant package and not realize it's a closed-end deal.

Donald E. Killen, President
Greenleaf Software, Inc.
Dallas, TX

SAS/Lattice announced late last summer that there would be no new development of the Lattice MS-DOS compiler—just after I had finished my review. Certainly a case of bad timing, and one for which I apologize. Perhaps a text box next to the review would have been in order. However, the picture for Lattice is not quite as black as you paint it. This past fall, Lattice informed customers that phone support and corrections to the compiler would continue. Present customers still have a good product in their hands. If you doubt this, join BIX and look at the comments people make about the Microsoft and Borland C compilers.—Barry Nance

. . . And Hold My Calls

I read with interest your Microbytes item "Monitor Noise Causes Stress, Researchers Say" (December 1990) and have to agree with the conclusions you report. I am a systems analyst with a large international corporation and spend most of my day at the computer. Even though I am male and have (presumably) a very low estrogen level, I find that the stress induced by my VDT is noticeable. I tried [researcher] Dow's suggestion of turning off my tube for 15 minutes, and lo and behold, my stress level went way down! Until my boss walked in and asked me what I was doing.

Kevin Petersen
MIS Department
World Wildlife Fund
Gland, Switzerland

Theos Kudos

Thank you for your feature about Theos ("Alternative Operating Systems, Part 3: Theos: Serious Business," October 1990). I have been programming exclusively in Theos since 1982 and have firsthand knowledge of the system's phenomenal growth. In today's world, where networks are the de facto standard, it takes courage to stand by a relative unknown that outperforms and underprices the alternatives. I have bet the future of my operation on Theos and have been successful so far. Perhaps enough people will have read your article so that in the future, as I receive the never-ending stream of dealer surveys, I will not have to check "Other" for operating system.

Craig A. Barcus
Barcus Business Systems
Santa Rosa, CA

Only Epson co
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Ada Aficionado

I read with interest the opinions of "63 of the world's most influential people in personal computing" ("The BYTE Summit," September 1990). The entire conference was conducted without a single reference to the House Appropriations bill H.R. 5803, sec. 8084, which says, in part, that "after June 1, 1991, all Department of Defense software shall be written in the programming language Ada."

Your 63 influential people appear to have a strong aversion to the language that is also a law. I don't really like medicine being rammed down my throat either, but as medicine goes, it tastes pretty good. Ada works.

I just finished a middling-size project on time, within budget, and in Ada. The university down the road is using Ada as the basic software engineering training language. My company, British Aerospace Australia, has all new work coming in with Ada as the specified language.

I suspect that all this will extend to the personal computer. The last language that the DoD got into was COBOL, and I'd hate to bet against Ada right now.

B. J. Chippindale
The Levels, Australia

Safe Data

I was particularly interested in reading Jerry Pournelle's comments in "The BYTE Summit" (September 1990) concerning the future of computing, and also the accompanying remarks in his column. I found myself agreeing with much of what he had to say, but one aspect of his thoughts bothered me—his law of "One person, at least one CPU." On the surface, it seems to be the best solution. What could be better than having complete control of your own computing destiny?

But I started to look at the issue from my perspective, as an engineer working in a large company, and I realized that having my own PC or even a personal workstation on my desk was not always going to be the way I would get the most work done. Perhaps my view has been warped because of the type of work I have been doing recently, large-scale computational simulations of optical systems (taking a slow Fourier transform of a 256- by 256-pixel array is a common feature of these), but I can get much more done in an hour by using any of six-odd mainframe computers that my company owns than by using the venerable AT on my desk. Indeed, many of the problems that I solve with computers can't be done by even the larger PCs. I would also extend this observation to the academic setting of the university I attend.

My point is this: Sharing large computing resources among many people is still an efficient way to get work done in a large organization. In my experience, both as a user and as a provider of shared computer resources, I have had many more positive experiences with mainframes than negative ones, and I expect that many people share this view. It simply makes sense for companies and institutions to invest in centralized resources that can be shared by a great many people at one time.

Besides being able to get more work done, having a centralized computer system helps a company keep its information organized and safe. Even after having two jobs in MIS departments, where my only task was "disaster recovery operations" (more mundanely known as backups), I still have terrible habits when it comes to my own PC, and I witness this same shortcoming in many PC users—even those who have been burned by lost data and programs. I realize that fast-developing sophisticated PC-network programs provide centralized backups, but in my mind, they're not there yet.

If a company wants to be truly safe, the only solution is to put data protection in the hands of a few employees for whom that is their only job. The other big advantage of having a centralized system is that databases are used consistently so that data integrity is always assured. Perhaps when PC-network software progresses further, this will no longer be a concern. But then again, maybe it will always be a concern. I tend to favor the latter because decentralization of information, computer-readable or not, always increases the risk of loss or damage.

In the end analysis, I believe that the best solution is having centralized computing resources available for all to use for big jobs and to access important databases. Along with that, it's best to have individual PCs or workstations that people use for smaller jobs and their own personal work that does not need to be shared with a great many people. This is my current situation, and I think it works quite well.

With improvements in networking and communication, data interchange between all levels of computers will soon (well, hopefully soon) be seamless and nearly effortless. And while PCs will continue to enlarge their circle of influence and power, I know that large systems will also have their place for a long while yet.

Thomas G. Adams
Rancho Palos Verdes, CA

Thanks for a thoughtful analysis. I'd like to have a longer discussion sometime.—Jerry Pournelle

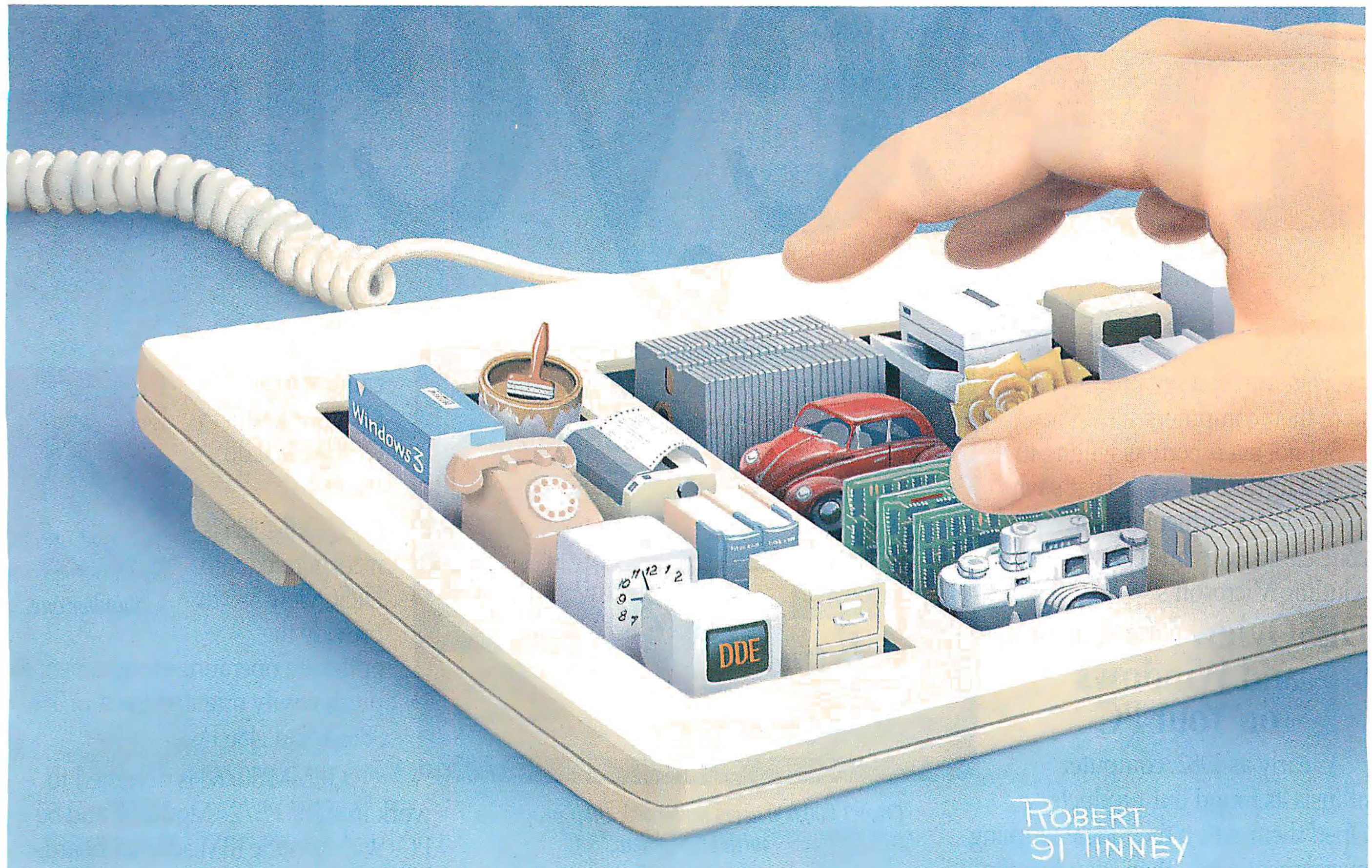
Jerry Pournelle's September 1990 column was interesting, entertaining, and educational, as usual. Unfortunately, while discussing his First Law, he fell victim to what Dr. Stanley Schmidt calls "extrapolatio ad absurdum." He assumes that diskless workstations are inherently "evil" and are perpetrated upon unwilling victims by diabolical "centralists."

This position overlooks the primary reasons that most companies install diskless workstations: data security and reliability. The mere fact that potential for abuse exists is no reason to assume that the abuse will indeed occur. If there is no disk drive, no data can be surreptitiously copied from the central hard disk and used in a manner contrary to the best interests of the company that owns the data.

Additionally, by booting from ROM and downloading all pertinent device drivers and user profile information, the common problem of corrupt boot disks is totally avoided. It should also be noted that individual users can customize their own working environment by loading TSR programs and utilities from the server. This method also has the benefit of allowing full compliance with software licenses, thereby avoiding potentially harmful and expensive civil penalties for software piracy.

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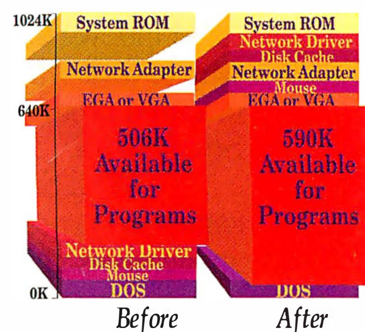


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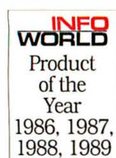
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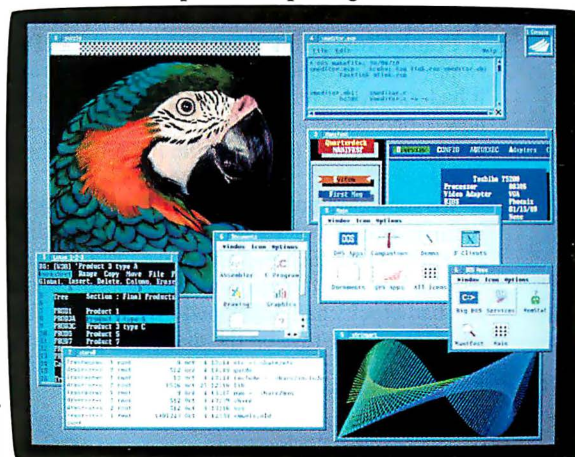
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disk can easily be accommodated by users (of which, typically, there will be several) who do have floppy disk drives in their workstations. Even if there is only one workstation on a network that has a floppy disk drive installed, and this particular unit is controlled by the "centralists," there is a wonderful opportunity to control access to sensitive corporate data while preserving the user's freedom to "liberate individual creative energies." This type of procedure also ensures that corporate data is not accidentally corrupted by honest mistakes or sinister intent.

I hope Jerry rethinks his position on these wonderful machines because they make the life of the network supervisor much easier.

Robert Foldi
Albion, NY

Well, you're probably right: I do sometimes get carried away. Thanks and best wishes. —Jerry Pournelle

Zapping Disks

In a letter to Chaos Manor Mail (October 1990), Frank Cross pointed out that he was careful to pass his floppy disks around the airport security x-ray machine. It had puzzled a fellow medical physicist and me as to how x-rays could affect floppy disks. Thus, we did a small experiment to determine if, in fact, there was any effect.

We subjected both 5¼- and 3½-inch floppy disks to increasing doses of x-rays from a standard diagnostic x-ray unit. After each exposure, we tested the disks using Norton Utilities to see if any data was unreadable or if any bad blocks had developed. We were unable to detect any effects of x-rays on the disks, despite the fact that the doses administered were orders of magnitude greater than those of any airport security system.

It would seem that the suspicion that x-rays will cause damage to disks is based on some sort of myth and that excessive precaution is unnecessary.

T. D. Cradduck
London, Ontario, Canada

I gave up on special treatment for disks years ago, and so far I haven't noticed any problems. But I was told that the U.S.S.R. x-ray machines really zap things (so much so that the KGB agents running them get medical problems). So there I did move the disks through manual inspection. I do worry a little about EPROMs in some computers, but again, I have never actually had a problem. Best wishes.—Jerry Pournelle

Disseminating Ideas

In his September 1990 column, Jerry Pournelle referred to a prediction he'd made in the past: "By the end of the millennium, any member of Western Civilization would be able to get the answer to any question that has an answer—and this at reasonable cost."

That brought an immediate question to my mind. Since it sounds like such a good deal, how does one become a "member of Western Civilization"? It seems a pity that people not fortunate enough to be born in a Western country (or a "westernized" country, such as Japan, which I believe Jerry would include in his prediction) should be deprived of what his prediction means (living long and prospering, for starters).

If Jerry can put a simple answer to the above question in his column, everyone everywhere could follow it and gain the benefits of his prediction. I'm thinking of places like Guatemala, for instance, which probably has a per capita income of about $250. Or Zaire, which has a per capita income of $150. Not to mention the Eastern European countries, now in the throes of applying for membership in Western Civilization (after having been held back for 40 years by the Communists).

For what it's worth, I'd suggest these simple requirements: free market economy, free flow of information and ideas, free entry and egress, and rule of law applying to everyone in all classes. What do you think? Jerry could just put the recipe in his column, and the rest of us will see that it's disseminated throughout the world to those who need to pay heed. Or better yet, he could write a science fiction book about it.

Timothy Condon
Tampa, FL

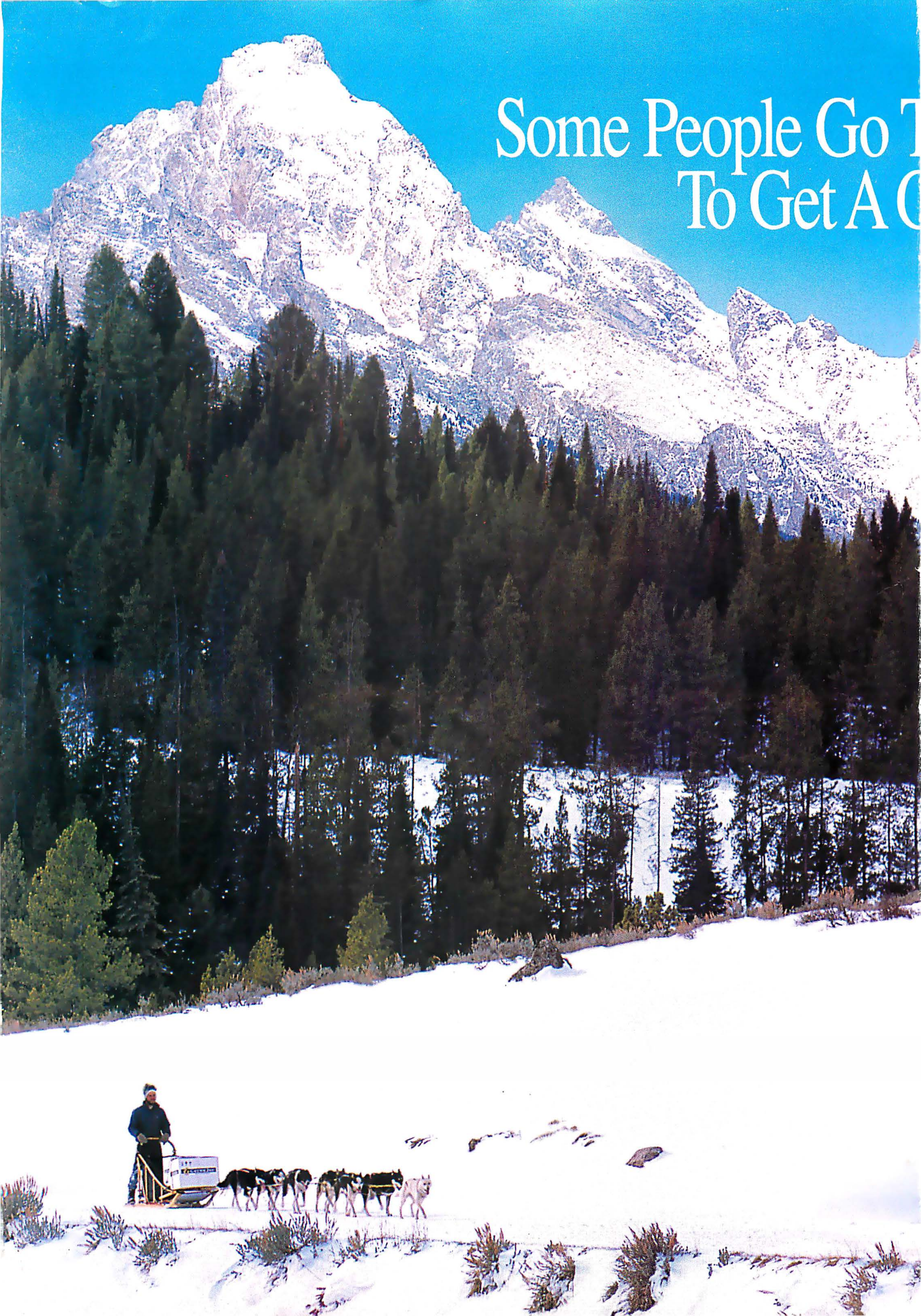
"America is the well-wisher to the freedom and independency of all. She is the champion and vindicator only of her own," said John Quincy Adams; and while I might dispute that, it is still something to be thought about.

Certainly the best way America can preserve Western values for the world is to retain them for herself; and perhaps, just perhaps, liberty of conscience, freedom of expression, security of property—a "just and impartial government that will not take from the mouths of the laborers the bread they have earned"—and rule of law will spread. Just perhaps.—Jerry Pournelle

FIXES

• Laurence M. Gartel is the artist who created the artwork used as a background for the collage that appeared on page 297 of the December 1990 issue of BYTE. This artwork was originally published in the book *Laurence M. Gartel: A Cybernetic Romance* published by Gibbs Smith, Publisher. Copyright 1989 by Laurence M. Gartel.
• Some of the company information listed for Perceptive Solutions, Inc., in the January Product Focus and the review of hyperStore was incorrect. The company is located in DeSoto, Texas; the correct telephone numbers are (214) 954-1774 and (800) 486-3278.
• In a January Short Take (page 127), we incorrectly identified the Volante AT1000 board as interlaced, when in fact it is noninterlaced.
• In the September 1990 Ask BYTE, the phone number we gave for Spinnaker Software was incorrect. The correct number is (617) 494-1200.
• The correct telephone number for Spiral Software (January, page 70) is (800) 833-1511.
• The correct telephone number for Dragon Systems, listed in "The BYTE Awards" (January, page 164), is (617) 965-5200. ■




Some People Go T
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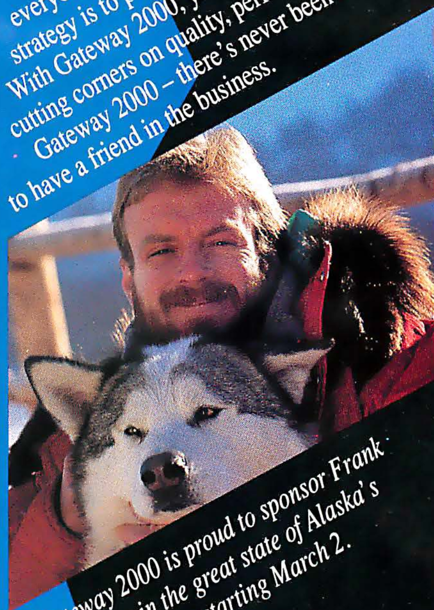
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NEWS
MICROBYTES

Microsoft Taps Windows to Support Pens

While some tap-happy pundits predict no future for computers that use a pen or stylus, Microsoft says that portable PCs and programs that tap into its pen-centric operating software could reach the market later this year.

Unlike GO Corp. (Foster City, CA), which has invented a whole new 32-bit operating system for pen-based, mobile computing (see "The Point of the Pen," February BYTE), Microsoft is building on top of Windows. The upcoming PenWindows, shown to developers late last month, is a set of operating-system extensions designed to recognize handprinted text and accept commands from a pen or stylus. The system will also recognize *gestures*, or pen marks for common commands such as cut, copy, paste, and insert. "Gesture support is the most important aspect of pen-based systems," said Greg Slyngstad, general manager of the PenWindows product unit. The handwriting-recognition engine is "installable," Slyngstad said. OEMs or applications developers can implement a different recognizer if they want.

Based on Windows 3.1, PenWindows will run any application compatible with 3.1 without modification. It's this compatibility with current software that Microsoft is promoting as the reason developers and users will want to pass GO.

For users who want to write instead of type, some developers will design versions of their software to handle pen input and take advantage of PenWindows capabilities. By building on a foundation of more than 600 functions in the Windows application programming interface, developers will be able to implement the PenWindows environment with modest incremental effort (about 35 additional functions), according to Microsoft. Microsoft itself plans to add pen enhancements to programs such as Word, Excel, and PowerPoint. The company released a beta software developer's kit last month.

Microsoft will license PenWindows to OEMs, who will install it in new tablet-like computers. Several companies have expressed an interest in PenWindows, including Momenta, Wang, NCR, and Kyocera.

While GO's PenPoint system is designed for stylus input, Microsoft is betting that users of pen-based systems will want compatibility with DOS and Windows rather than a brand-new operating system. PenPoint is compatible only with the DOS file system. However, tacking pen-based features to an existing operating system may limit both the performance and flexibility of the pen-based environment. For example, Microsoft's system will require translation of pen input into mouse or keyboard equivalents (a procedure that GO's system doesn't have to worry about). Some experts on pen-based computing believe multitasking will be of critical importance to ensure adequate responsiveness of the pen.

Still, Microsoft has the clout of 20 million DOS users and can attract developers more easily than GO. Slyngstad said that "one or more" systems—most likely notebook 386 PCs with a removable display—will show up this year.

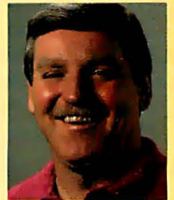
—Nick Baran and D. Barker

Grid Will Work with PenPoint and PenWindows

While some computer makers will implement GO's PenPoint and others will implement Microsoft's PenWindows, the first company to commercially provide a handwriting-savvy stylus-and-tablet computer will support both environments. Grid Systems (Fremont, CA) plans to build an industry-standard computer that can be used for either PenPoint or PenWindows, as well as programs written for Grid's own application programming interface, says

NANOBYTES

Why is this man smiling? He's **Robert Puette**, president of **Apple USA**, and his company is selling its new Mac Classic computer faster than it can make them. And according to market analysts, Apple is reaching a whole new audience of computer users with its low-cost machines. At a recent press briefing, Puette said that Apple's strategy is to be "customer driven" and provide total computing solutions in cooperation with reseller channels and developers, the "other sides of the triangle centered around the customer that we don't and can't control." Coincidence or not, following Puette's talk and similar briefings by fellow Apple executives John Sculley and Michael Spindler, Apple's stock jumped several points. Apple's stock has risen steadily since official statements about gaining market share have passed reality checks with increases in sales.



Apple officials now say that the **lightweight notebook computer** under development will be out by August. Word in the Macintosh community is that Sony will build the little machine, expected to weigh about 6 pounds.

In a move expected to bring large profits to U.S. software manufacturers, ministers of the **European Common Market** have approved new legislation **extending copyright protection to software**. With reports estimating that U.S. vendors annually lose up to $5 billion in sales due to European software piracy, strong copyright protection is high on the companies' list of priorities. The directive passed by the European

PHOTOGRAPHY: APPLE COMPUTER/PETER FOX © 1991

company president Alan Lefcoff.

Grid will basically stay on the sidelines and watch the action between GO and Microsoft, Lefcoff said. Although he thinks that GO should have based its system on Windows, Lefcoff said that he believes independent software vendors will develop good pen-based applications for the GO environment. Grid has no interest in building custom hardware for PenPoint and asked GO to modify its design accordingly. Grid users might have to load in a modified BIOS to run GO software, he said.

Meanwhile, the GridPad has been successful with truck drivers and insurance sellers, says Grid product manager Ken Delaney. The portable system (suggested price, $2370) is frequently used for capturing signatures, he said. However, the GridPad's handwriting recognition capabilities are used in only 20 percent of the applications developed for it, he said.

—Rich Malloy

Nutek Claims True Mac Clone; No Mac ROMs Required

No one's done it yet—made a Mac clone that doesn't use Apple's own Mac ROM chips and can still get past Apple's attorneys. But Nutek Computers (Cupertino, CA) says it has designed a set of chips and software that form a "legal functional equivalent of the Macintosh operating system." Nutek hopes to sell its Mac replicant technology to computer makers who want to produce Mac clones.

Nutek says that it has developed a Mac-compatible operating system that doesn't infringe on any of Apple's patents or copyrights. The company says that computers based on its cloning package—an operating system on disk and in ROM and three application-specific ICs that mimic the Mac's internal hardware functions—will be binary and bus compatible with the Mac. Any "clean" Mac program, peripheral, or add-in will work with systems that are based on the Nutek design, said company president Benjamin Chou. Manufacturers using the Nutek chip set must add the CPU, which can be anything from a 68000 to a 33-MHz 68040; a SCSI controller chip; memory; and glue logic.

As for the user interface, Nutek will offer a native-language Mac version of the Open Software Foundation's Motif. This could help avoid problems with Apple's interface copyrights.

Reverse-engineering a Mac clone is quite a technical accomplishment. But the fast-selling Mac Classic has changed the scenery. Now that Apple offers a real low-cost Mac, the demand for imitations isn't what it was a year ago, when the cheapest model had a price tag twice that of an IBM clone. However, Chou said that OEMs who use Nutek's core technology won't try to compete "with a single, low-end product." They'll offer machines that are more flexible than Apple's and "competitive on a price/performance basis," he said.

—D. Barker

New Type of Magnetic Memory in Development

The developers of a new form of magnetic memory say that their approach will yield fast, nonvolatile devices that could someday replace conventional CMOS RAM. This so-called Sheet RAM could ultimately replace "any and all memory devices except things like real cheap floppies and streaming tapes," says Richard Lineau, inventor of the technology and a principal in the company commercializing it. SHRAM Memory Technologies (Los Angeles) expects to have working devices soon. The first products using Sheet RAM could appear sometime this year, Lineau said.

Like other forms of magnetic memory, Sheet RAM is nonvolatile and relatively immune to stray radiation. Unlike other kinds of magnetic memory, Lineau says, it can match the speed of conventional CMOS RAM.

Sheet RAM consists of a thin layer of ferromagnetic material put down on a neutral substrate, with a single Hall-effect transistor for each memory cell formed on top of the ferromagnetic layer. Conceptually, Sheet RAM is most akin to core memory—the arrays of tiny magnet doughnuts woven on wire that dominated computer memory before semiconductor RAM came along. Like core, Sheet RAM stores bits by changing the polarity of magnetized regions. Unlike core, the magnetized regions are not discrete components. Instead, they are regions on a chip, like the domains in

NANOBYTES

Council of Ministers is now in the hands of the European Parliament, which should be making its decision soon. "This directive takes strong action to redress the piracy, an absolute necessity if a healthy indigenous software industry is to develop in Europe," said Floyd Bradley, European vice president of Ashton-Tate. The legislation sanctions reverse engineering under strictly limited circumstances. Firms will be allowed to decompile competitors' programs to ensure compatibility with their own products and will be forbidden from examining code not directly related to achieving this. Information gained from decompilation cannot be used for purposes other than ensuring compatibility.

As computers get smaller, input devices are doing the same. This month, **Appoint** (Paso Robles, CA) expects to start delivering a trackball about the size of a Chunkie bar. Thumbelina measures 1½ by 1½ inches and is ¾-inch high. The three-button device uses what the designers call a "single point contact, friction operated mechanism," the same as in Appoint's MousePen. You can easily hold the trackball in one hand and control it with your thumb, a spokesperson said. The PC version has a PS/2 mouse connector and serial adapter. The Macintosh version hooks to the Apple Desktop Bus port. Thumbelina is priced at $99.

Wolfram Research (Champaign, IL) plans to multiply the number of systems that can run its **Mathematica** program. The latest version is initially coming out for the Mac, Next, Sony, and Sun platforms, but the company plans versions for a further 11 or so platforms, including Windows, 386-based DOS, DEC, IBM RISC System 6000, MIPS, and Silicon Graphics workstations. Wolfram added hundreds of math functions to version 2, the most important related to solving numerical differential equations.



1-2-3 works with either DOS or Windows 3.0. You don't have to change the way you work to work with Release 3.1



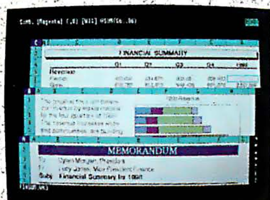
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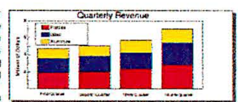


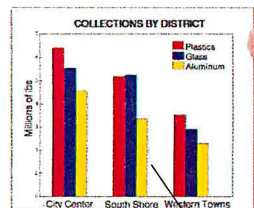
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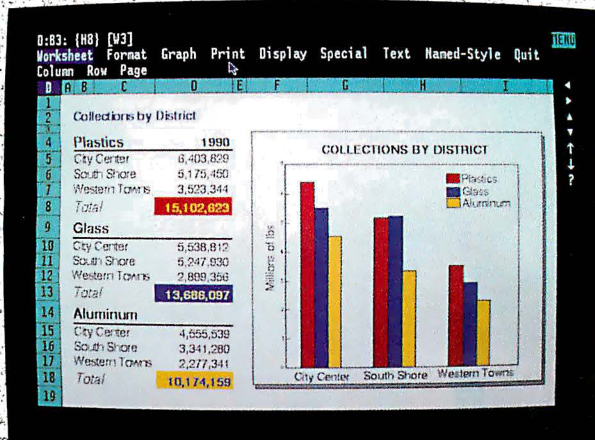
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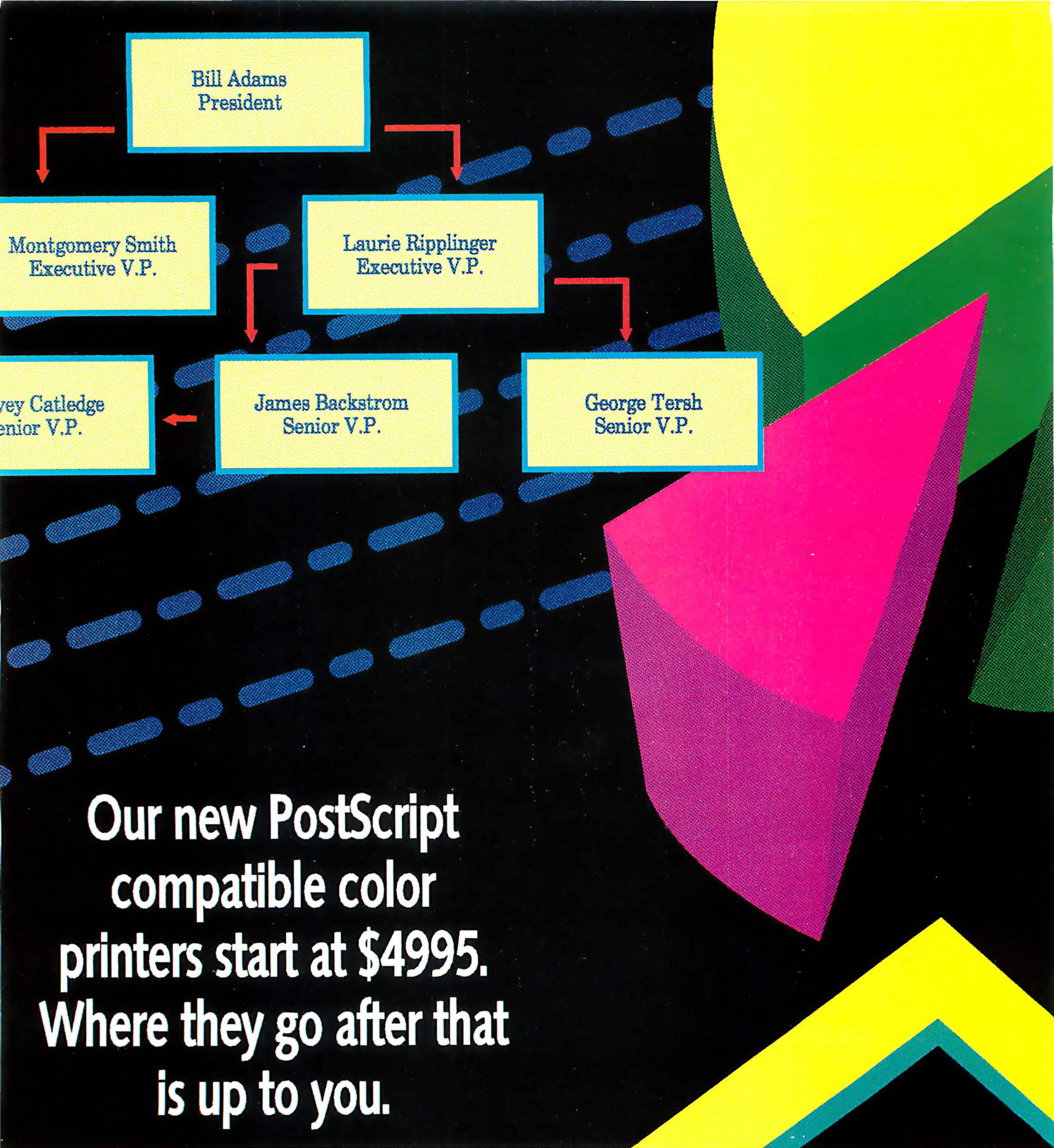


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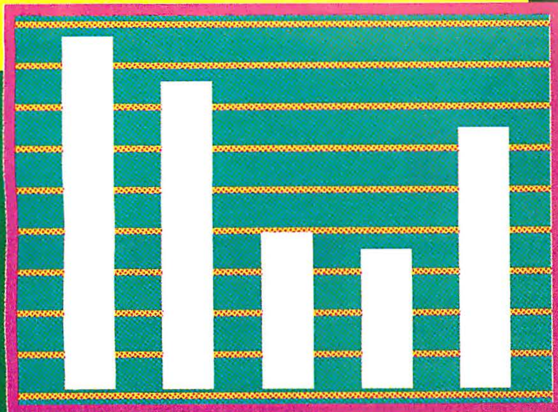


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bubble memory. Unlike bubble memory, these magnetic domains do not have to move to be read and written. They are addressed and read like conventional RAM.

The first silicon will be built using 25-micron design rules. The company expects that eventually Sheet RAM can be as dense as conventional DRAM. Lineau indicated that Sheet RAM would initially be more expensive than DRAM.

Other start-ups invented new magnetic-memory technologies but had trouble bringing them to market. "We have a number of big names watching us closely and who have an interest in developing an end product," Lineau says.

—Rick Cook

Lotus Says Windows Version Keeps 1-2-3 @ the Top

While Microsoft hopes to persuade Windows users to make the new Excel 3.0 their spreadsheet of choice, Lotus says that people will wait for its Windows version of 1-2-3. Company officials say that 1-2-3 for Windows, which is currently being beta tested and could arrive by midyear, will help keep 1-2-3 in its position as the top PC spreadsheet.

Lotus will respond to Excel 3.0 later this year with a release that Jeffrey Beir, director of product marketing, said will achieve three design goals: 100 percent compatibility with existing 1-2-3 files, macros, and knowledge; a "no-compromise" Windows interface with full use of the Windows look and feel; and the richest set of features of any DOS or Windows spreadsheet, including things now available only in 1-2-3/G.

Exploiting the window of opportunity caused by Lotus's lack of a full Windows spreadsheet, Microsoft is "creating a sense of urgency in the market that customers have to make a decision today" about which spreadsheet to use under Windows, Beir said. According to Beir, beta testers have said that they think the wait for 1-2-3 is worth it.

Judging by market figures, Microsoft must sell Excel to nearly every buyer of Windows 3.0 to have the kind of customer base that Lotus has with 1-2-3. According to analysts at International Data Corp., Lotus shipped nearly 2 million copies of 1-2-3 last year. Borland's Quattro came in second, with an estimated 600,000 shipments, and Excel third, with 400,000.

—Andy Reinhardt

Support Chips Will Help Bring 50-MHz 486 PCs

A new chip set will help system designers bring the coming generation of 50-MHz 486 machines to market later this year. United Microelectronics Corp. (UMC) (Santa Clara, CA), a Taiwan-based semiconductor manufacturer, offers a set of support circuitry for AT-style computers built around Intel i486 and 386 processors running at speeds as high as 50 MHz.

UMC's 82C480 consists of an integrated memory controller (featuring cache controller), system controller, and peripheral controller, as well as some logic components. "We use a 1x CPU clock design," which takes advantage of the i486's 1x clock input, said UMC marketing manager Eric Chen. Even though Intel implemented a 1x clock design in the i486, typical chip sets in 486 machines use a 2x design, which means the clock signal generator is twice the speed of the system clock. In such machines, a 50-MHz clock speed would need a 100-MHz signal—not practical with current PC board technology. The UMC chip set enables a system to "run stably at 50 MHz," Chen said. "Another performance booster we provide is the built-in cache controller with write-back operations," Chen added.

The first company to announce that it's using the 82C480 is Velox (Santa Clara, CA), which has put the chips on a motherboard equipped with the IceCap, a thermoelectric refrigeration module. The IceCap keeps the 33-MHz i486 on the IceJet-486 board at 0°C, so the i486 can run reliably at 50 MHz and not malfunction from overheating. Company president Mel Snyder claims that the $3990 IceJet gives PC users "workstation performance" of 22 million to 35 million instructions per second.

UMC's chip set will show up in new PCs in about two months, according to Chen, who said 13 companies are currently working on designs that use the high-speed chip set.

—D. Barker

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BioControl Systems (Palo Alto, CA) has demonstrated a prototype of a device that lets you **control on-screen objects simply by moving your eyes**. At the recent Virtual Reality conference, one person used the EyeController to manipulate the actions of a fighter plane in a Commodore Amiga video game. The unit's sensor is attached to a headband that the user wears. It monitors electrical field movement (of the eyes) and moves the cursor (or game program object) on-screen accordingly. Hugh Lusted, coinventor of the device, is looking for "seed money" to bring the product to market. He sees the EyeController as a $100 games device that would plug into the joystick port of a PC. The company hopes to get the product to emulate a mouse.

Companies designing **X Window hardware and software** can have their products tested in a new heterogeneous evaluation lab. **AGE Labs** (San Diego, CA) performs testing and benchmarking of products such as X terminals and application software. AGE's program uses the Xlib Protocol Test Suite, the MIT Volume Stress Test, its own test suite, and hardware from multiple vendors, including Hewlett-Packard, Sun, IBM, and DEC.

Computer-related titles are among the **best-selling CD-ROMs**, according to the **Bureau of Electronic Publishing** (Parsippany, NJ). From the top, the 10 biggest sellers near the end of 1990 were Grolier's Encyclopedia, Microsoft Programmer's Library, Microsoft Bookshelf, PC-SIG Library, Between Heaven & Hell II, Computer Library, McGraw-Hill Science and Technical Reference, CIA World Fact Book, U.S. History on CD-ROM, and Compton's Encyclopedia.

Planning to focus solely on the corporate marketplace, **Software Publishing** (Mountain View, CA) is getting out of software for single users. The company has

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C-PROGRAMMERS: See for yourself how Vermont Views™ can help you create user interfaces the *easy* way.

If you want to start saving a *tremendous* amount of time and effort, call for your free Vermont Views demo kit and put us to the test. Vermont Views is a powerful, menu - driven screen designer that comes with a C library of over 550 functions. Which means you can create user interfaces in just a fraction of the time it takes to write the code yourself!

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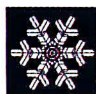
Let's face it. With most systems, you have to throw away your prototype when coding begins. Which means you waste precious time and effort. With Vermont Views, things are a lot different. In fact, the prototype actually *becomes the application*. So menus and data-entry forms are usable in the final application without change. Names of functions for retrieving, processing, and storing data can all be specified as the prototype is created. And that's just for starters.

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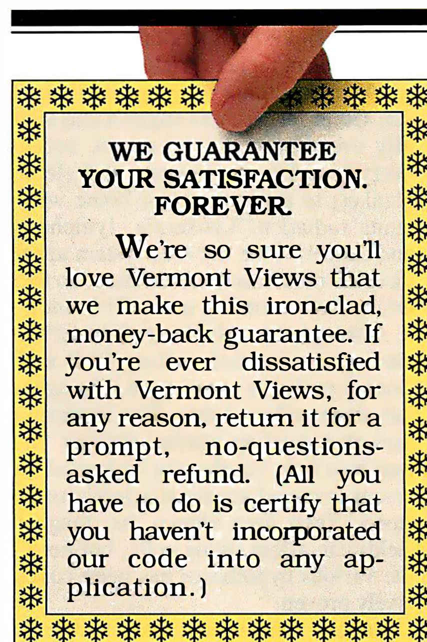
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Delayed EPA Study Says Evidence "Suggests Link" Between ELF, Disease

Following public awareness and growing concern among some researchers, the Environmental Protection Agency has finally released its report on possible links between cancer and low-level electromagnetic fields (ELF), such as those emitted by CRTs and computers. Other researchers suggest that virtually everyone could be at risk because everything from computers and electric blankets to appliances and home wiring emits radiation. Leukemia, lymphoma, and cancer of the nervous system are the diseases most likely to be related to these emissions, according to the EPA study.

Although an early draft of the EPA review recommended calling ELF emissions a probable carcinogen, the agency has since softened that. The report now says that existing studies suggest there may be a link, but that the biological processes involved are insufficiently understood. Tests have shown that magnetic fields can affect living cells, but none of the various hypotheses has been conclusively proven.

Earlier studies have indicated an increase in the miscarriage rate among women using CRTs in excess of 20 hours a week. David Savitz, a professor of epidemiology at the University of North Carolina, concluded that risk of cancer increased by 30 percent among children who used extremely low-frequency-emitting electric blankets, and that the number of brain tumors was double to triple in children whose mothers used electric blankets while pregnant.

Dr. William Farland, director of the EPA office that issued the report, told BYTE that the EPA's document concluded that each of the studies to date had several deficiencies. "On the whole there is not one study that convinces us that there may be a link," he said. "But the overall weight of evidence suggests a link at this point." Further research would help to clarify the nature of the exposure and better understand the biological implications, he said.

Farland emphasized that there is still a long way to go before the EPA can even talk about strong associations, much less show cause-and-effect relationships.

The study, originally scheduled for release last November, was held up on the insistence of officials at the White House. White House sources told BYTE that the release was delayed so that material emphasizing the need for further study could be added. The EPA's Science Advisory Board and a White House interagency group will review the contents of the report. The resulting study is expected to be completed by fall.

—Allan Davidson

QIC Backup Will Get Quicker, Bigger

Choosing the right backup system will be getting tougher in the next few years. Different technologies will compete to offer the most storage capacity and the fastest access time, but proponents of quarter-inch tape systems say that that medium will leap ahead of digital audiotape (DAT) systems and 8-millimeter helical-scan systems in both capacity and speed.

Manufacturers of quarter-inch tape systems say they expect later this year to be selling 5¼-inch disk drives and media that can hold 1.35 gigabytes of data, or roughly 2.7 gigabytes after compression. (Current capacity is 525 megabytes.) New 3½-inch minicartridges will hold up to 380 MB, triple what they hold now, manufacturers say. And by 1995, some quarter-inch tape cartridges will be able to store as much as 12 gigabytes of uncompressed data, according to QIC, an association of companies involved in quarter-inch-tape backup systems.

QIC vendors say that the advantages they offer over other backup choices are cross-platform interchangeability of cartridges, strongly enforced backward compatibility, lower drive cost, and proven technology.

Compared with 4-mm DAT, QIC is slower at file access (typically 30 to 40 seconds versus 15 to 20 seconds for DAT) but faster at data transfer. The question of transfer speed will become more important in the future, as QIC drives are slated to climb up to over 1 MB per second. According to InfoCorp analyst Mike Casey, DAT drives will double their data transfer speed in the next few years but will not be able to keep up with the increases planned for QIC.

QIC's trump card is a dramatic boost in cartridge capacity, which will be enabled by two fundamental technology changes: a shift to barium ferrite media,

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sold its PFS: product line of inexpensive, easy-to-use programs to Spinnaker Software (Cambridge, MA), which specializes in the home computer/small business market. Software Publishing will now concentrate on the more lucrative but more competitive business market with its Professional and Harvard series and the new InfoAlliance, a LAN-based product for accessing information from different databases.

Spinnaker plans to bring its newly acquired PFS: programs, such as First Choice and First Publisher, to new operating environments. It plans to announce a Windows 3.0 version soon.

AppleTalk III will probably be out in three or four months to let users boot up a Mac remotely. But a small company called **Mauswerks** (Columbus, OH) has come up with a way to make **diskless booting** possible over Ethernet. BootToob ($139), which consists of a ROM and software that works with existing Ethernet cards, basically creates a bootable RAM disk in local memory that it downloads from the server via Internet Protocol. Once the bootable image is created, the connection is broken with the server (unlike AppleTalk III, which at last glimpse maintains constant connection with the client machine).

Much to the surprise of some Macintosh observers, the new **Mac LC can work with VGA monitors** when used with the right cable. When asked why this fact hadn't been promoted, an Apple spokesperson said, "We wanted to test it to make sure it worked."

Xing Technology (Arroyo Grande, CA) has implemented the Joint Photographic Experts Group compression algorithm in a new program and offers its code to hardware and software developers. Xing is also selling its own version in a new program called VT-Compress, a $179 package

Toshiba's New Disk Medium Is No Small Accomplishment.



There's 13 Years Of Extra-High Density D

In this age of information, the voracious appetite for magnetic data storage capacity is never satisfied. Each new generation of computers brings higher performance and demand for more and more memory.

In personal computers and workstations, new applications like desktop publishing, computer-aided design and medical imaging are stretching the limits of conventional floppy disk and disk drive technology. And new technologies like digital audio tape and high definition television are placing unprecedented demands on recording techniques and media.



Every 4 MB Extra-High Density disk you buy will carry the symbol ED—ED tells you you're buying Toshiba technology.

Toshiba Corporation anticipated this developing logjam in storage capacity as long ago as 1978, when it began research and development activity into a promising alternative to conventional longitudinal magnetic recording technology. That alternative—perpendicular recording—if perfected and made producible, promised to increase the recording density of magnetic media by at least an order of magnitude.



Today, in 1990, Toshiba's intensive research and development, led by Dr. T. Fujiwara, has resulted in the perfection of media that are optimized for perpendicular recording, and the production of commercially available 3.5 inch floppy disks with the remarkable capacity of 4 MB unformatted.

New Perpendicular Recording Technology

Today's conventional, longitudinal recording is reaching its limits for high density data storage. Using longitudinal recording, data is written into the magnetic medium by magnetizing adjacent cells *parallel* to the plane of the medium's surface. In perpendicular recording, magnetization of the individual cells occurs in a direction *perpendicular* to the plane of the recording medium.

To take advantage of perpendicular recording, Toshiba perfected the use of a new magnetic medium. This new medium is Barium Ferrite.

Disk And Drive Technology

Toshiba has ushered in the era of high density recording with the development of the new 3.5 inch extra-high density floppy disk utilizing the barium ferrite medium, and new associated floppy disk drive.

The double-sided disk has an extraordinarily high recording density of 35 kilobits per inch—more than four times higher than conventional floppy disks. Yet the disks have a track density of 135 tracks per inch, the same as in conventional 3.5 inch floppies. The barium ferrite disks feature extremely high reliability—dependable performance for more than 10 million revolutions.

For high density recording and playback using this new barium ferrite 3.5 inch disk, Toshiba made certain modifications to disk drive head and drive mechanical designs. This new Toshiba disk drive technology, licensed to companies around the world, preserves downward read-write compatibility with conventional 3.5 inch 1 MB and 2 MB disks.

Under license from Toshiba, many firms in the U.S. and Japan are proceeding to exploit barium ferrite technology and several have introduced commercial



Toshiba's development of the barium ferrite medium began in 1978, led by Dr. T. Fujiwara. Today, Toshiba holds the patents for barium ferrite as a recording medium.

A Chronology Of Important Milestones In The Development Of Barium Ferrite Media For Perpendicular Recording.

1978	12/82	7/85	1/86	4/87	9/87	4/88	9/88
Researchers at Toshiba R&D Center establish concept of barium ferrite as a medium for perpendicular recording.	*Barium ferrite tape demonstrated for the first time in the world at Toshiba Private Show.*	*Toshiba displays and demonstrates first 3.5" floppy disk and drive at National Computer Conference.*	*Toshiba Ba-Ferrite floppy disk selected as one of the top new products of 1985 by Nikkan Kogyo Shinbun.*	*Toshiba announces development of a Ba-Ferrite 3.5" 16 MB technology.*	*Toshiba announces a commercial version of Ba-Ferrite 3.5" 4 MB FDD and available licensing of FD/FDD technology.*	*At Comdex, Data Technology announces a 5.25" 20 MB FD/FDD product utilizing Ba-Ferrite media.*	*Toshiba and TEAC announce a Ba-Ferrite 3.5" 4 MB FDD that is 1" high and downward read/write compatible with 1 & 2 MB disks.*

Extra Effort In Every isk We Make.

products. Currently, standardization of the 4 MB technology has been progressing worldwide led by Toshiba and other manufacturers.

In addition to Toshiba, other companies are also extending the recording density of barium ferrite above the 20 MB range on 3.5 inch disks, by utilizing the superior characteristics of barium ferrite and new schemes for recording and tracking.



When you see this symbol on an Extra-High Density disk, that's your assurance that you're buying not only Toshiba technology—but Toshiba quality as well.

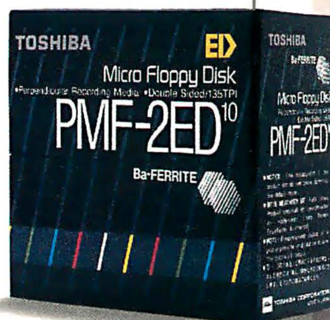
Other Applications Of Barium Ferrite Technology

Toshiba's barium ferrite technology shows equal promise for other high density applications such as computer data tapes, 8mm VCR tapes, DAT tapes and future high definition television VCR tapes.

The use of barium ferrite also allows high speed contact duplication of pre-recorded tape. The speed of duplication can be several hundred times higher than can be accomplished in machine-to-machine real time duplication.

All told, the enhancement of recording media embodied in Toshiba's barium ferrite technology applied to perpendicular recording promises to extend the density of today's magnetic storage products well beyond that available today. And the technology will certainly give rise to new media applications where high density, high performance and extremely high reliability are required.

For additional information about barium ferrite Extra-High Density disks, ask the company that developed the technology—Toshiba. Telephone 1-800-843-2108.



What's Barium Ferrite?

The particles used in conventional recording media are shaped like needles, and therefore difficulties arise in maintaining perpendicular orientation throughout the manufacturing process. Barium ferrite particles, on the other hand, are tiny flat platelets, hexagonal in shape, that can be readily arranged to have their easy axis of magnetization perpendicular to the platelet plane.

Barium ferrite has long been used as a permanent magnet material, but the particles for permanent magnets have grain sizes too large to be suitable for high-density magnetic recording. However, Dr. Fujiwara and Toshiba's researchers have developed ultra-fine barium ferrite particles with optimum shape, size and magnetic properties.

The Toshiba researchers also perfected a glass crystallization method for the manufacture of the ultra-fine barium ferrite particles.

The process begins by mixing glass, barium ferrite components and the ion substitution components and melting them at high temperature. The mixture is poured between rotating nip rollers for rapid quenching and forms glass flakes. These are heated again to crystallize them. The crystallized barium ferrite particles are extracted by dissolving the remaining compounds with acid, then rinsed and dried. This process produces very fine, separate particles of uniform size with excellent magnetization properties.

In the next step, a magnetic paint is made by mixing the barium ferrite particles in a mixture of binder resin and solvents and other ingredients. The magnetic paint then can be coated onto base polyester films and dried, and the surface smoothness enhanced by rolling. After curing, the films can be cut to form tapes, or punched out in the form of flexible disks.

11/88	*12/88*	*2/89*	*3/89*	*2/90*
Ba-Ferrite products at Comdex: Iomega 5.25" 44 MB, Brier 3.5" 21 & 43 MB, Insite 3.5" 21 MB & Qume/ Kodak 5.25" 20 MB FD/FDDs	*Toshiba introduces the JW-530, a Japanese word processor employing a Ba-Ferrite 3.5" 4 MB FD/FDD.*	*Logitec announces the LFD-302, an add-on subsystem for the PC98 series using a Ba-Ferrite 3.5" 4 MB FD/FDD.*	*Sharp introduces the DP-3000, a desktop publishing system using a Ba-Ferrite 3.5" 4 MB FD/FDD.*	*Canon introduces a desktop publishing system using a Ba-Ferrite 3.5" 4 MB FD/FDD.*

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which allows data bits to be oriented vertically, increasing their density and magnetic stability; and servo tracking, which will boost the number of tracks on a quarter-inch tape from 32 up to 144.

Archive, Wangtek, and Tandberg have indicated that they will offer 1.35-gigabyte systems with data transfer rates of 600K bytes per second and average access of 36 seconds, with OEM prices of about $700. Sometime this year, 3½-inch systems holding 380 MB and with data transfer speeds of up to 500K bytes per second are expected to arrive from Irwin, Maynard, and Colorado Memory Systems. By 1993, QIC vendors plan to support 6 gigabytes of storage in the larger format and 2 gigabytes in the smaller. The large drives will be able to transfer data at up to 1.2 MBps, QIC members say.

—Andy Reinhardt

Chip Helps Smooth Laser-Printed Images

Laser-printer manufacturers can offer the type-smoothing capabilities that Hewlett-Packard claims with its newest LaserJets, thanks to a new chip. Destiny Technology (Milpitas, CA) has designed circuitry that it says significantly improves the look of output from laser printers by finding and smoothing the jagged edges of raster images.

Destiny's Edge Enhancement Technology takes a different approach than the Resolution Enhancement feature in HP's LaserJet III but controls the laser engine to provide comparable output. EET looks at line segments in a raster image and then "smooths out the jagged representation," a company spokesperson said. HP's technique, built into a patented application-specific IC, uses dot modulation; it looks at a group of dots that make up an image and tells the printer to make the dots smaller in areas where cleaner edges are needed (e.g., in the sharp ends of letters, or at the intersection of lines).

EET yields the most noticeable results with italic type and small characters, according to Louis Yang, Destiny's vice president of sales and marketing. "If you print 10-point Times Roman all day, you probably won't notice much difference" with EET or with Resolution Enhancement, Yang said. EET won't slow down the time it takes to print a page, he said.

Half of the top 10 laser-printer and engine makers are working on designs that use the programmable EET chip, Yang said. Destiny officials declined to name the manufacturers who are evaluating the chip. OEMs who use EET can offer laser printers with the same output capabilities as the LaserJet III and sell those printers at a shade less than HP, Destiny officials say. EET-equipped printers will start showing up by June or July, Yang said.

The EET chip, called the D9001, costs $20 each in batches of 1000. Destiny has applied for a patent on its edge-smoothing technique. The company, which specializes in page-printer controllers, also offers a hardware/software emulation of HP's PCL 5 printer language.

—D. Barker

New Software Will Go Beyond E-Mail

Beyond (Cambridge, MA), a young company that was formed by former Lotus vice president Chuck Digate, is working on two PC programs designed to help users stay afloat in the ocean of E-mail.

The aptly named Beyond Mail will allow you to write rules for your existing E-mail system to filter messages by topics or keywords and take action on those memos. Another product, called @Mail, will let you send and receive E-mail from within Lotus 1-2-3 release 2.x spreadsheets and Symphony.

The DOS program is designed to handle information overload by sorting your mail and responding appropriately. It lets you add semistructure to your mail using rules that take action on messages according to their origin or content. For example, before going on vacation, you could write a rule that forwards all messages from your boss containing the word *urgent* to the coworker covering for you that week. "We're not just removing the chaff but also categorizing things," said product manager Eugene Lee. "If you have a tool that lets you categorize things, then in a sense, it also lets you prioritize it." A tickler feature allows you to store messages that don't require immediate response; they are put in your "to-do" box instead.

Beyond Mail uses the Message Handling Service, the protocol adopted by Novell that provides applications with an

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for IBM PCs. Company president Howard Gordon said that the program can shrink a 24-bit image from 768K bytes to 35K bytes in about 8 seconds when running on a 25-MHz 386 PC. The Xing code is small enough to be packed into ROM, Gordon said. The company is working on a version for SPARC systems, he said.

While there's been a stream of new "lossy" data-squeezing products for the Macintosh, **Sigma Designs** (Fremont, CA) has brought out a package that uses **lossless compression** techniques; in other words, it doesn't eliminate data to shrink a file. Sigma says that its $299 DoubleUp add-in board can compress any type of file "by an average of two to one." The board uses a 40-MHz processor from **Stac Electronics** to compress and decompress files. Sigma claims that DoubleUp compresses files as much as eight times faster than software methods now on the market. DoubleUp comes with DiskDoubler 3.0, a compression software utility from Salient Software.

As computers get smaller, they get easier to purloin. But a French company is bringing to the U.S. a "**registry service**" it says will **cut down theft** of equipment or make it easier to get stolen equipment back. **STOP** (Stamford, CT), which stands for Security Tracking of Office Property, says that its patented marking system has reduced the theft rate by 95 percent at sites where it's been used. The technique puts a permanent tatoo, including an ID number, on a piece of equipment. If the equipment is stolen, you report the ID number to STOP, which notifies law enforcers. The idea is that thieves won't rip off tatooed equipment because no one will want to buy it from them. STOP said that its customers overseas include Apple Europe.

Apple's recent **move toward Ethernet** is but one of a new wave of networking-related

DR DOS 5.0. WE COULDN'T HAVE SAID IT BETTER.

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MemoryMAX™ for one thing. A breakthrough in memory management that can give you more than 620K so you can run today's memory-intensive applications, including, for example, dBASE IV® on Novell NetWare®.

In fact, John Dvorak calls MemoryMAX nothing short of "amazing."

The Press goes on to mention that because DR DOS 5.0 is fully DOS compatible, you can run all your current DOS applications. And because it is easy to install and requires no hard disk reformatting, upgrading to DR DOS is simple. Since DR DOS 5.0 also includes ViewMAX™, a graphical interface, DOS is easier than ever to use.

Now if we could just get a word in edgewise, we would simply like to add that DR DOS 5.0 is available now. Call your local dealer today.

DR DOS 5.0



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For Laptop and Notebook manufacturers, DR DOS 5.0 is fully executable from either RAM or ROM. And, it's available with BatteryMAX™, a battery-saving feature that can increase battery life 2–3 times (dependent upon OEM implementation).

Circle 91 on Inquiry Card.

interface for store-and-forward message distribution over networks, so mail can be forwarded to or received from other MHS-compatible E-mail programs, such as cc:Mail.

The program is supposed to ship sometime in this half of the year and cost between $200 and $300 for each user. A Windows version is in the works.

—**Dave Andrews**

System Lets PCs Run Mac Software

Hydra Systems (Cupertino, CA) has developed technology that lets IBM PC users run Macintosh software on their computers. The Hydra approach basically puts the guts of a Mac in the form of ROM chips and a 68000 onto a board for the PC and then adds some very intelligent software to map Mac calls to I/O devices onto existing PC hardware. Hydra claims that its Hydra One (price expected to be less than $1000) allows a standard IBM PC to run Mac programs faster than a Mac Classic.

The current product maps Mac screen I/O to EGA or VGA and maps all other Mac I/O activity appropriately to the PC serial port, parallel port, or wherever. You can directly cut and paste to and from the PC and Mac screens, as well as transfer files between the two systems, the company says.

DOS software controls Hydra's board, and the software lets you split the screen and see part of both the DOS and Macintosh screens by sliding the Mac screen. Hydra says that it has not found any software that will run on the Classic or SE that won't run on its board.

The current Hydra board, however, does not support Color QuickDraw, the 68020 or 68030, or the memory management unit. The Hydra system does not make any attempt to support the Apple Desktop Bus. Instead, it maps ADB calls to the keyboard and to Microsoft Mouse–compatible devices. Will Glaser, director of engineering at Hydra, said that the company made this decision some time ago since the majority of users would own PC hardware and not ADB devices. "There is more [in the way of I/O peripherals] on the PC side than the Mac side," he said.

—**Owen Linderholm**

3Com the Latest to Drop Work on OS/2; Passes LAN Manager Back to Microsoft

OS/2 is being tossed from one developer to another. 3Com (Santa Clara, CA) has become the latest company to play "hot potato" with development on the operating system.

First, Ashton-Tate jumped off the SQL Server project and handed responsibility for it back to Microsoft. Then Microsoft handed responsibility for 16- and 32-bit versions of OS/2 for Intel platforms back to IBM. And now, as part of a major reorganization, 3Com has gotten rid of LAN Manager, tossing the troublesome tuber back to Microsoft.

3Com has transferred to Microsoft the 3+ and 3+Open LAN Manager 2.0 technology that the companies had been developing together to run on top of OS/2. Microsoft will incorporate additional 3Com technology into future versions of LAN Manager; new features will include Apple Macintosh and Novell NetWare connectivity services and X.500 directory services.

3Com continues to sell 3+Open LAN Manager 1.1 and Mac, NetWare, and TCP/IP value-added services to customers who need these capabilities today.

Instead of trying to provide complete networking solutions, 3Com is getting out of the software business to concentrate on network adapters and hubs, internetwork gateways (bridges and routers), and multiprotocol communications servers.

—**Andy Reinhardt**

TECHNOLOGY NEWS WANTED. *The news staff at BYTE is interested in hearing about new technological and scientific developments that might have an impact on microcomputers and the people who use them. If you know of advances or projects relevant to microcomputing, please contact the Microbytes staff at (603) 924-9281, send mail on BIX to Microbytes, or write to us at One Phoenix Mill Lane, Peterborough, NH 03458. An electronic version of Microbytes, which offers a wider variety of computer-related news on a daily basis, is available on BIX.*

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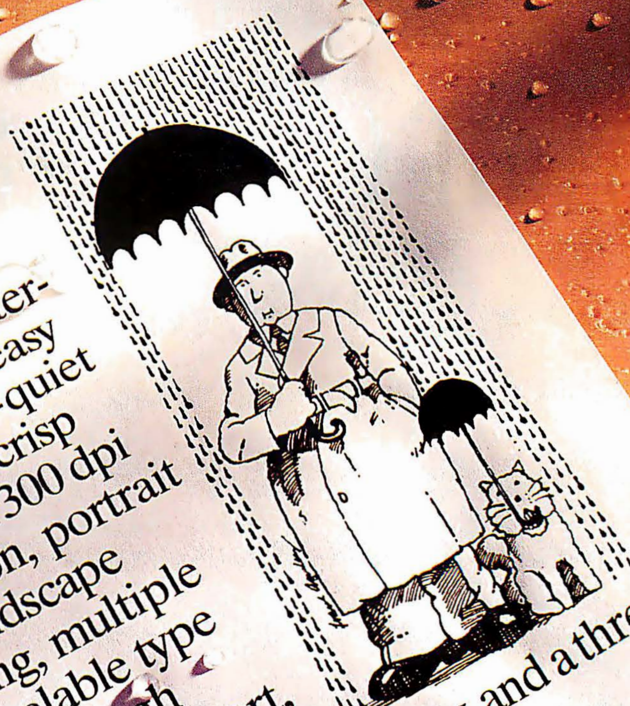
announcements for connecting Macs to other computers. At the recent Mac Expo in San Francisco, more than a dozen companies introduced connectivity products, most of them related to Ethernet. Among those companies are Asante Technologies, Cabletron, Dayna, Farallon, National Semiconductor, NRC, Nuvotech, Shiva, and Synoptics.

Responding to a "national need for engineers and scientists with a practical knowledge of Japanese," the College of Engineering at the **University of Washington** has established a master's program in **technical Japanese**. The program offers studies in engineering or science fields as well as courses in reading and speaking Japanese. The school is now accepting applicants; the program is slated to begin in the fall.

Elsewhere in the cyberworld, **Virtual Technologies** (Stanford, CA) says that it is working with another company, Beyond Technology, to develop TeleCAD, a **virtual design environment** for creating, editing, and manipulating three-dimensional virtual objects. One of Virtual's products is the Cyberglove, an I/O glove with sensors for finger, hand, and wrist movement. Cyberglove comes with software for displaying a graphical representation of the user's hand and finger motions on the computer screen.

The color LCD developed by **InFocus Systems** (Tualatin, OR) could show up in a **new Compaq computer** soon. The computer maker has licensed InFocus's Triple Supertwist Nematic display technology (described in the January Microbytes). InFocus says that its passive-matrix technology beats the active-matrix approach because it's available now and is considerably less expensive to manufacture. Compaq officials wouldn't say if or when a TSTN LCD will be used in a Compaq computer, but other sources said that it will later this year.

Born not to run.



Hewlett-Packard inkjet technology now gives you non-smear, water-resistant ink, easy and whisper-quiet operation, crisp and black 300 dpi resolution, portrait and landscape printing, multiple and scalable type fonts through Windows support, 2+ pages per minute, full industry compatibility, and a three-year, rain-or-shine warranty.

The new DeskJet 500

$729

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HEWLETT PACKARD

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The 386 Gets a Competitor

STAN MIASTKOWSKI AND RICK GREHAN



Advanced Micro Devices' 386 "clone" delivers identical performance to Intel's flagship chip

Despite the fact that Intel's i486 processor is the latest and (supposedly) greatest of today's CPUs, the 386 remains the workhorse standard for much of today's routine computing needs. It's likely to remain that way for quite a while. The i486 is still too expensive for all but the most elite of power users, and prices don't seem to be going down.

After years on allocation, the 386 is now in plentiful supply. Intel ships huge numbers of the chips (the company won't say how many) every month. And when you're the only supplier on the block (as Intel currently is for the 386), you can pretty well set the price you like. Industry analysts say that Intel has kept the price of the 386 artificially high and is raking huge amounts of dollars into its corporate coffers. Yes, prices of 386-based systems have been slowly falling over the past year, but that's largely a function of the falling price of RAM. The cost of the processor itself hasn't changed much.

That situation, however, may change quickly. BYTE Labs has been testing the first "clone" of the 386. Advanced Micro Devices (AMD) has developed the Am386, and we've found that it's a virtual dead ringer for the Intel chip. Our tests find the Am386 is 100 percent compatible with the 386, and it has a couple of additional features that will mean some surprising developments for the ubiquitous PC platform.

A Clone's a Clone for All That

We've put the term "clone" in quotes because it's been a bit overused in the PC market. The Am386 isn't a true clone of the 386, because it can't be. A clone is an *exact* copy. The Am386 may work exactly the same as the 386, but it's certainly not an exact copy, because the people at AMD wouldn't have a legal leg to stand on if they simply took a microscope and copied the 386. (The legal landscape remains murky, however. See below.)

AMD used nearly 30 people in two different teams to develop the Am386. One team of AMD engineers dissected the 386's silicon, slowly building a road map of the chip's internals. They used this to construct a gate-level simulation of the 80386. Another team ran batteries of sample 386 code through working parts, logging incoming and outgoing signals on all the CPU's pins.

Once the people at AMD had a working version of the simulation, they fed it the microcode and then pumped simulated input signals into it. The simulation returned output signals, and they compared these with the logs taken earlier. Whenever a discrepancy between the simulation and the real world showed up, the engineers dug back into the dissected chip, comparing it with their simulation in search of their mistake. They'd find the error, correct the simulation, and continue running tests.

The Am386 uses the Intel microcode bit for bit. How can the same microcode run on dissimilar hardware? Obviously, the AMD engineers have altered the hardware to be compatible with the software, rather than the other way around.

When the simulation was sufficiently accurate, AMD had what amounted to a *logical* description of the 80386. The simulation consisted of a mass of logic gates.

It was during the translation of that logical description to the physical description—which actually maps out how the chip is built—that the differences between the Intel part and the Am386 part appeared. From there, it was a short trip to actually fabricating the prototype chips, which AMD said were running DOS, OS/2, and Windows within 48 hours of leaving the fabrication facility.

The Promise of Low Power

AMD plans to release two versions of its clone. The Am386 is a simple pin-for-pin replacement for the 386. But it's the other chip that offers some interesting possibilities. Unlike the 386, which uses low-power CMOS technology in only a small part of the chip, the Am386DXL is a full-CMOS chip that uses (in its 20- and 25-MHz configurations) only one-third the power of the 386. (The 33-MHz incarnation uses two-thirds the power of the comparable Intel chip.)

In addition, the Am386DXL can tolerate clock speeds down to 0 MHz. It accomplishes this thanks to the static nature of its internal registers; they need no clock signals for refreshing their memory. At 0 MHz, the Am386DXL draws only 1 milliampere of current, resulting in a true "sleep" mode. AMD also plans to market a 132-pin plastic flat-pack version of the chip. Because it's 40 percent smaller than the standard ceramic part (and should cost less), it's clear that the era of the full-fledged 32-bit laptop/notebook computer will soon be upon us.

The Proof Is in the Testing

In terms of performance, the Am386 is a clone with no enhancements. Operationally, it's an exact duplicate of the 386, right down to each clock cycle. We ran BYTE's low-level CPU tests on both an Am386 and a 386 in a Compaq Systempro. The tests turned up no surprises; the AMD part performed identically to the Intel version. (The results are shown in the figure.) The discrepancies between the two chips in some tests are so small that they're negligible.

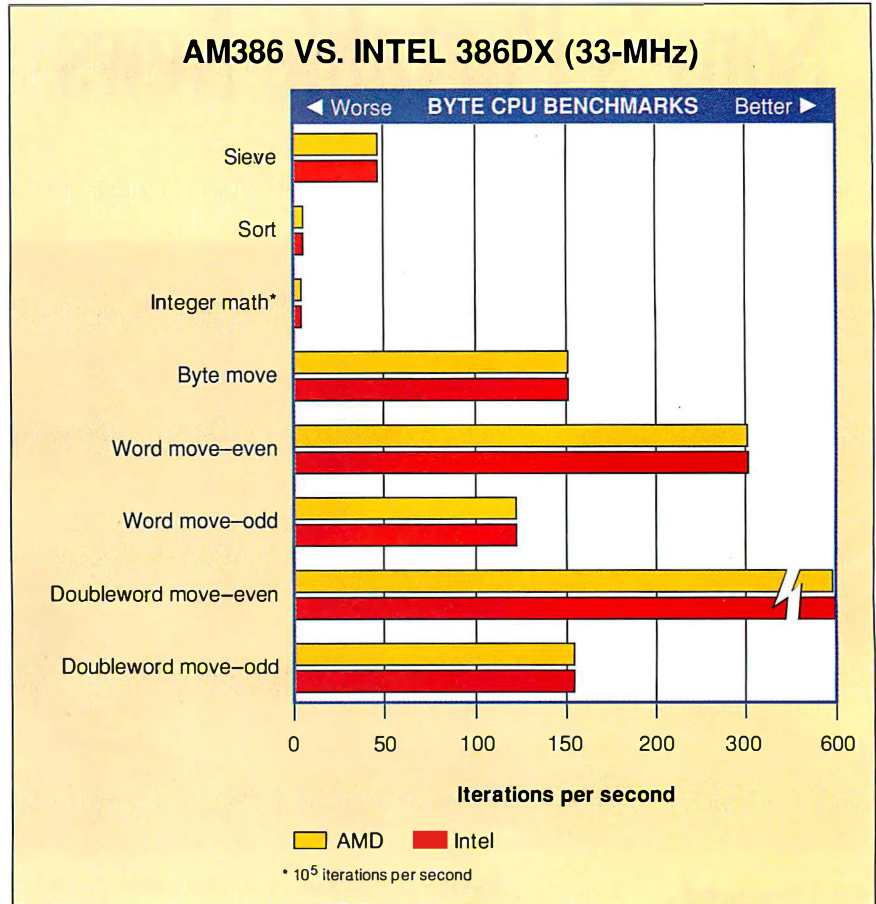
We also ran the Am386 in one of our lab's mongrel 386 clones for the better part of two days, allowing the lab's normal activity to put the chip through its paces. It ran a variety of applications and participated as a Novell NetWare client with no problems whatsoever.

We also had available a V-ATE system diagnostic board from Vista Microsystems. The V-ATE plugs into any ISA slot, "wakes up" during the system's power-on self-test processing, and monitors the bus for any anomalies. Not surprisingly, the V-ATE gave the system running the Am386 a clean bill of health.

Up in the Air?

Although AMD was careful to develop a compatible chip that's *not* a gate-for-gate copy of the 386, Intel isn't taking the competitive threat lightly. Although the details of the legal battle going on between the two companies are too complicated to go into here, the actual question of whether AMD will be allowed to sell its chip is still. . .interesting. But one hint that AMD may have its way is that a judge refused Intel's bid to prevent AMD from using the name "386" for its chip. At press time, AMD wouldn't release any price information or delivery dates. All a company spokesperson would say is that AMD will ship "substantial quantities in the first half of 1991."

One thing's for sure: Competition fosters innovation, and AMD's 386 clone is sure to mean lower system prices and more powerful portable systems. For once, end users may turn out to be the real winners. ■



The AMD Am386 and Intel 386 processors are, for all practical purposes, identical in performance. (The occasional differences are too small to matter.) All units are iterations per second except integer math, which is 10^5 iterations per second.

THE FACTS

Am386
Price and availability unknown at press time.

Advanced Micro Devices
P.O. Box 3453
Sunnyvale, CA 94088
(800) 222-9323
(408) 732-2400
Circle 1012 on Inquiry Card.

Stan Miastkowski is BYTE's senior editor for new products. You can contact him on BIX as "stanm." Rick Grehan is technical director of the BYTE Lab. He can be contacted on BIX as "rick_g."

Sony's Portable News

BEN SMITH



An 18-pound RISC-based graphics workstation

Reviewing the history of Unix workstations, I see cabinets getting smaller, processors getting faster, and prices going down. There is one constant: the massive high-resolution screens. A graphics workstation's color monitor can easily weigh 60 pounds; even a monochrome screen can weigh 30 pounds. Moving the CPU cabinet may have become easier, but moving the whole assembly—including monitor, network interface, and cables—takes at least two strong backs. As a result, workstations have become furniture. Taking one into the field has been out of the question. . .until now.

Portable But Not a Laptop

Even though the product literature calls it a laptop, the Sony RISC-based portable News 3250 workstation weighs 18 pounds and requires standard AC current and an external transceiver to connect into a network. You need space to operate the mechanical mouse. This workstation is designed to be set up on a desk and plugged in.

Its label says "Network Station." The network connection and power cable will easily fit into a pocket of the case. The entire workstation now is portable, meaning that it isn't too heavy to carry the length of an airport concourse. And when you set it up wherever you arrive, you have a serious monochrome graphics workstation.

The back of the base has an Ethernet port, a SCSI port, a (nonstandard) parallel port, and a serial port. A 3½-inch floppy disk drive is on the right of the base. The base is crowned with the 11-inch display, 1120 by 780 supertwist nematic LCD pixels, evenly backlit with good contrast.

The keyboard lowers from the base, providing a comfortable typing angle on the 75 full travel keys. The keyboard layout is a little strange, particularly for a portable, since it includes some dummy keys and only 10 function keys, a standard on Sony News workstations. The mouse plugs into the right side of the keyboard; an array of miniplugs for the input and output for audio processing plug into the left side of the keyboard.

An anomaly is the recessed membrane switch on the upper left of the keyboard, which is labeled "Power On." Unlike the Next computer, you do not press this switch to power off the system as well; you just use it to power on the system. On this machine, the Unix administration program, `shutdown`, is responsible for killing the power, after it has stopped all the processes and unmounted the file systems.

Packed Inside

As you've probably surmised, this is no ordinary portable computer. Central to the design is a 20-MHz MIPS R3000 RISC CPU joined by a MIPS R3010 floating-point coprocessor, 32,000 bits each of data cache and instruction cache. The net result is a computer that performs 17 million integer instructions per second and 1.8 million floating-point instructions per second.

The basic RAM (in the U.S.) is 8 megabytes, expandable to 36 MB. The single-in-line-memory-module (SIMM) slots are accessible through a simple sliding panel below the screen. The internal hard disk drive (either 240 or 406 MB) is manufactured by Hitachi. The SCSI port lets you add any of the Sony News external SCSI devices (e.g., a magneto-optical rewritable drive or a 1.3-gigabyte digital audiotape drive) or just an external hard disk drive.

The compact power supply is mounted above the CPU and FPU in the left rear of the base, so that they can be properly cooled by the quiet fan. The audio interface (16-bit and 8-bit stereo A/D and D/A processors) is squeezed in with the mouse interface on a card under the keyboard. Even with all this hardware

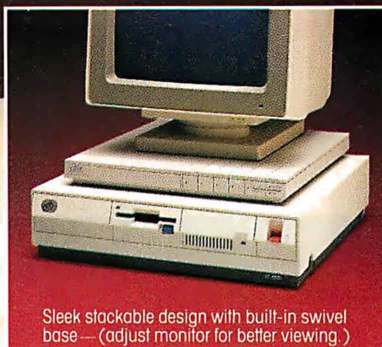
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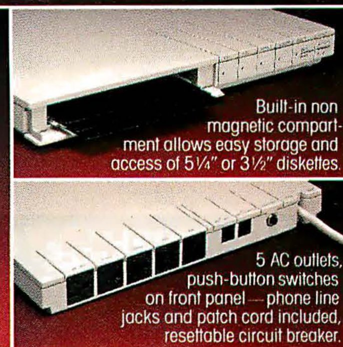




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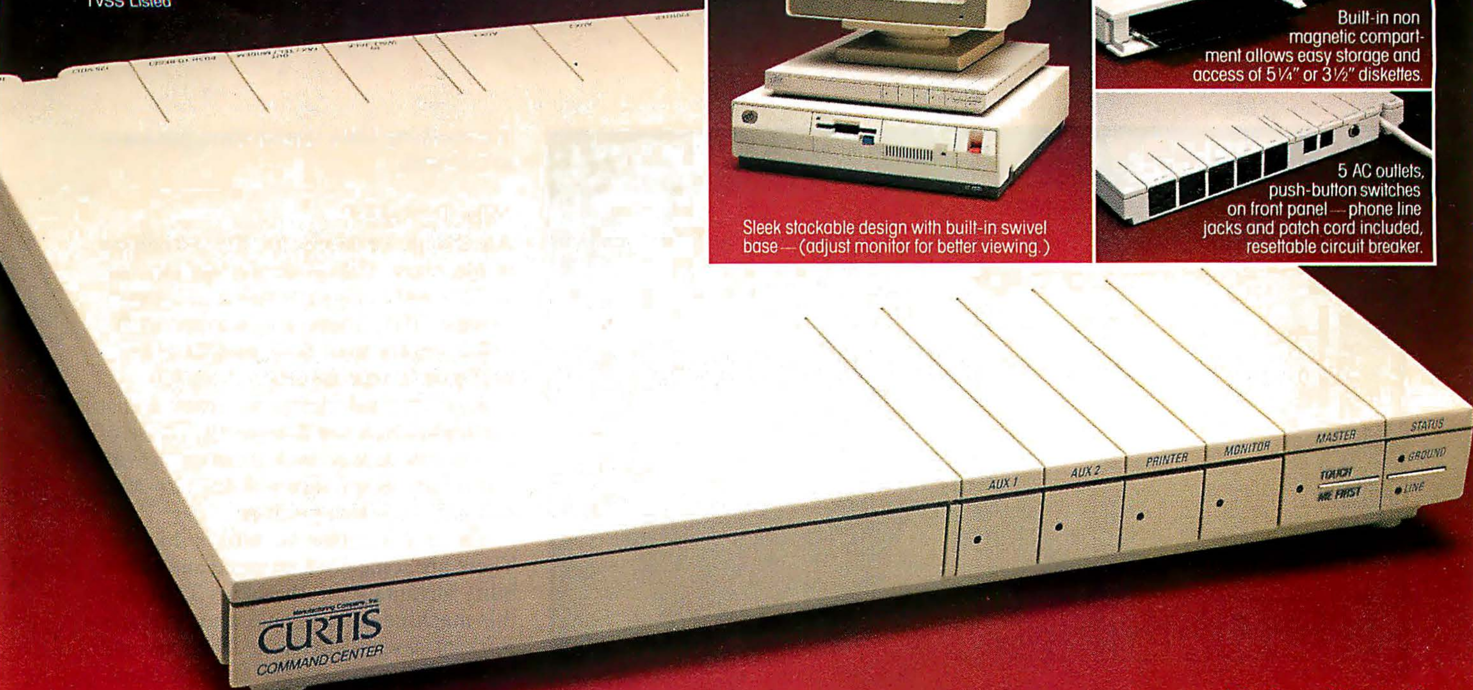


Sleek stackable design with built-in swivel base—(adjust monitor for better viewing.)



Built-in non magnetic compartment allows easy storage and access of 5¼" or 3½" diskettes.

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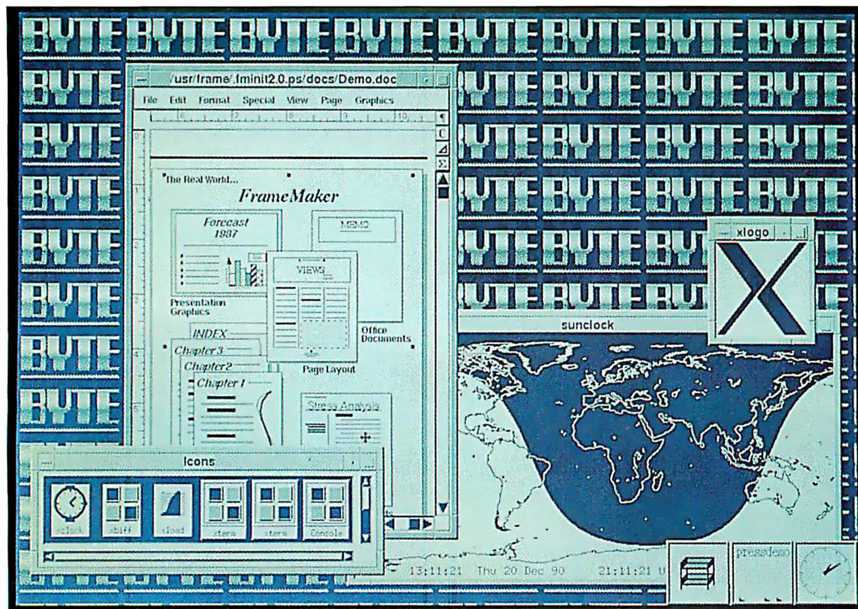


Photo 1: *The LCD has high enough resolution to run graphics applications and desktop publishing software such as FrameMaker.*

THE FACTS

Sony News 3250
Base system (240-MB hard disk drive), $9900; with 406-MB hard disk drive, $11,900

Basic Configuration:
CPU: R3000 (20 MHz)
FPU: R3010 (20 MHz)
Cache: 32,000 bits (data); 32,000 bits (instruction)
RAM: 8 MB, expandable to 36 MB
Floppy disk drive: 3½-inch 1.44-MB
Internal hard disk drive: 240 MB or 406 MB
Display: 11-inch backlit STN LCD
Standard interfaces: SCSI (half-pitch), serial, parallel, Ethernet
Audio: 16-/8-bit A/D and D/A stereo/mono
Power requirements: 1.0 ampere AC 120V
Weight: 18 pounds

Sony Microsystems Co.
645 River Oaks Pkwy.
San Jose, CA 95134
(408) 434-6644
fax: (408) 954-0849
Circle 1167 on Inquiry Card.

packed into such a small case, there is still room for a Sony expansion slot.

It takes more than hardware to generate a high-performance system: The compiler is the MIPS optimizing compiler, one of the best in the industry. The operating system is the new Unix System V release 4, a rewrite of Unix that combines older System V releases with Xenix and Berkeley Standard Distribution Unix. The sound library and editor are Sony's.

The system ships with the Open Software Foundation's Motif window manager, which is a poor choice for a monochrome display because it relies on a large palette of colors to create its elegantly designed windows and buttons. Open Look is more appropriate for monochrome, while providing more functionality without add-on packages for environment and file management.

"Portable" implies "quick to start" and "quick to stop." These concepts are not part of the Unix environment; Unix does not start and stop instantly with the flip of the power switch.

It takes the portable workstation a good 2 minutes from the time you press "Power On" to when you can use the machine. It takes nearly 4 minutes to shut down. Even small-kernel, ROM-based versions of Unix take this long, so inertia is something Unix system users just learn to live with.

Why Portable?

Another price to pay for the portability of the News 3250 is display quality. An LCD is not as clean or quick as a monochrome CRT. There is no way to attach a better display until Sony designs a frame buffer to fit into the empty Sony bus.

Another small design weakness is that the keyboard is not detachable. Those of us who like to lean back in our chair with a keyboard in our laps will have to sit up straight to use this machine.

The real question is, who is this for? There are some obvious space and portability advantages to the News 3250. But this machine is for people who regularly work at several different locations and need a personal system at each place: consultants, field engineers, and designers who could use a workstation to present their ideas.

A great deal of the feasibility of a portable workstation is derived from working in a Unix network environment with the Network File System. By exporting the portable's file systems to another machine, you can work on a more comfortable workstation when one is available. Also, you don't have to worry about keeping all the systems up to date, since there is only one copy of the files, the one you see on any system that has the Sony's files remotely mounted.

There isn't any loss of computing power or speed. In fact, the News 3250 is sufficiently powerful to handle CAD and desktop publishing applications with an ease that will bring a smile to any user.

There is a tremendous amount of functionality here: a mature and robust operating system running on a well-designed, high-performance machine packaged in a neat and portable case. The weakest point is the display; but even here, Sony is not using old technology.

Plenty of applications are already available for this processor and the X Window System, including FrameMaker (see photo 1).

Putting all this together, you will find that Sony's portable RISC-based News workstation fits so many diverse requirements that it is a valuable machine for the office as well as the field. ■

Ben Smith is a technical editor for BYTE. He can be reached on BIX as "bensmith."

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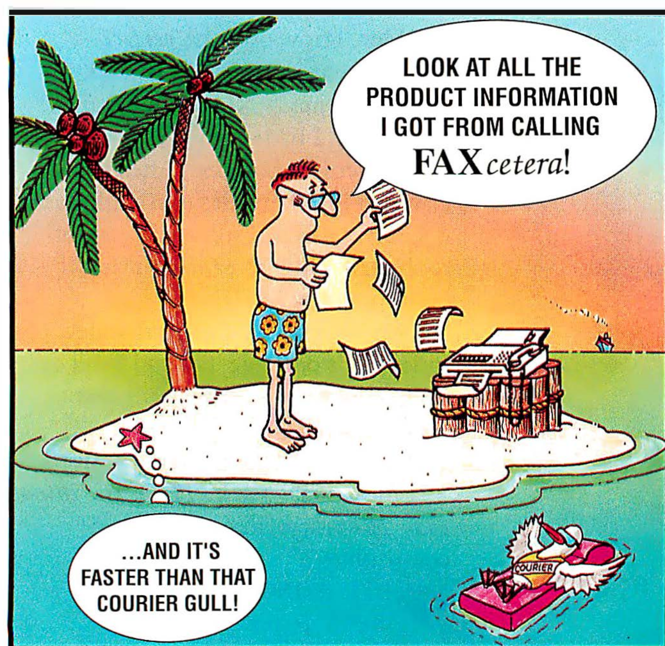
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BlueMAX	155	129
C Windows Toolkit/386	200	179
C-Terp 386	398	315
Lahey F77L-EM/32 (w/OS/386)	1290	1035
MetaWare High C 386	995	919
Novell C Network Compiler/386	995	799
PC-lint 386	239	179
WATCOM C 8.0/386 Prof.	1295	1099
w/ 386/DOS Extender	1790	1399
WATCOM C 8.0/386 Standard	895	719
WATCOM FORTRAN 77/386	1095	929
Zortech C++ Devel. Ed. 386	995	849

ADA

	LIST	OURS
Ada Assembler	395	369
Ada Scope Debugger	495	445
Ada Training Environment	895	805
Adagraphics	695	629
IntegrAda	795	719
PC Professional Devel. Kit	1995	1659

ASSEMBLY LANGUAGE

	LIST	OURS
Advantage Disassembler	295	279
ASMFlow Professional	200	179
MS Macro Assembler	150	105
OPTASM	150	129
Re:Source	150	129
Sourcer w/ Pre-Processor	170	139
SpontaneousAssembly	199	169
Turbo Debugger & Tools	150	105

BASIC COMPILERS

	LIST	OURS
MS BASIC Prof. Devel. System	495	349
Power Basic	129	89
QuickBASIC	99	69

BASIC LIBS/UTILITIES

	LIST	OURS
GraphPak Professional	149	129
P.D.Q.	129	115
ProBas	159	149
ProBas Toolkit	99	94
QBase	149	125
QuickComm	149	119
QuickPak Professional	169	149
QuickWindows Advanced	149	119

CASE TOOLS

	LIST	OURS
EasyCASE Plus	295	259
Professional Pack	395	355
Personal CASE	199	179

C COMPILERS

	LIST	OURS
Instant C	795	719
Intel 386 C Code Builder	695	489
Lattice C 6.0	250	155
Microsoft C 6.0	495	339
w/Objective-C	699	539
MS QuickC 2.5	99	69
MS QuickC w/ QuickAssembler	199	139
Turbo C 2.0	99	69
WATCOM C 8.0 Professional	495	419
WATCOM C 8.0 Standard	395	335

C++

	LIST	OURS
C++/Views	495	419
Data++Windows	189	169
NDP C++	495	479
Rogue Wave Math.h++	200	179
Rogue Wave Tools.h++	200	179
Turbo C++	CALL	CALL
Turbo C++ Professional	300	205
Competitive Upgrade	150	139
Zinc Library	200	179
Zortech C++	200	165
Zortech C++ Database	300	255
Zortech C++ Developer's Edition	450	399
w/ C++ Views	945	595
Zortech C++ Video Course	500	449

C-COMMUNICATIONS

	LIST	OURS
Breakout II	249	189
C Asynch Manager 3.0	189	139
Essential Communications	329	259
Greenleaf CommLib	359	279
Greenleaf ViewComm	399	319
SilverComm "C" Async Library	249	215
View-232	189	149

C-FILE MANAGEMENT

	LIST	OURS
Btrieve Devel. System	595	479
C DATA MANAGER	295	259
w/ source	595	522
Multi-user	895	785
Codebase IV	295	219
c-tree Plus	595	475
dBC III Plus	500	439
db_FILE Bundle	295	249
Essential B-Tree w/ source	198	149
The Toolbox - Prof. Edition	1095	799
The Toolbox - Special	695	509

C-GENERAL LIBRARIES

	LIST	OURS
C Function Library	99	79
C TOOLS PLUS/6.0	149	109
C Utility Library	249	199
Greenleaf Functions	229	179
Greenleaf SuperFunctions	299	239
Turbo C TOOLS/2.0	149	109

C SCREENS

	LIST	OURS
C-Worthy	399	CALL
Greenleaf DataWindows	395	315
Vermont Views	495	415
Vitamin C	395	289
VC Screen	149	125

C-UTILITIES/OTHER

	LIST	OURS
Bar Code Library	389	319
"C" EMM Library	149	119
C Shroud	198	149
C-DOC	189	169
Clear for C	200	169
INTERWORK	189	165
MKS LEX & YACC	249	197
Objective-C	249	225
PC-lint	139	105
PCYACC Professional	495	459
TimeSlicer	295	279

COBOL LANGUAGE

	LIST	OURS
Micro Focus:		
COBOL/2 w/ Toolset	1800	1499
Dialog System	600	539
Personal COBOL	149	129
MS COBOL	900	629
Realia COBOL	995	849

DATABASE DEVELOPMENT

	LIST	OURS
Clarion Personal	79	72
Clarion Professional 2.1	845	585
Clipper 5.0	795	521
Data Junction Advanced	299	269
dBASE IV	795	495
dBFast/PLUS	345	295
dGE	295	249
Dr. Switch-ASE	180	149
Facelt	99	90
FlashTools!	89	79
Flipper	195	169
Force 2.1	695	589
FoxPro	795	489
FUNCKy Library	195	179
R&R Code Generator	150	129
R&R Report Writer	150	129
Say What?!	50	39
SilverComm "C" Interface	99	89
SilverComm Library 2.0	249	209
The Documentor	295	245
Tom Rettig's Library	100	80
UI2 Version 2	595	479

DEBUGGERS (DOS)

	LIST	OURS
MultiScope	179	139
Periscope Debuggers	CALL	CALL
Trapper	200	179
w/optional cable	240	219
Turbo Debugger & Tools	150	105

DOCUMENTING/FLOWCHARTING

	LIST	OURS
allCLEAR	300	229
Clear for C or dBASE	200	169
C-Clearly	130	115
Flow Charting 3	250	199
Interactive Easyflow	150	125
Source Print	99	74
Tree Diagrammer	99	74

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	LIST	OURS
BRIEF 3.0	249	CALL
EDT+	295	269
EMACS	395	315
Epsilon	195	159
KEDIT 4.0	150	125
MKS Vi	149	129
PI Editor	195	175
Sage Professional Editor	295	249
SLICK Editor	195	169
Speed Edit	295	275
SPF/PC	245	199
SYNDIE	495	395
VEDIT PLUS	185	115

EMBEDDED SYSTEMS

	LIST	OURS
C6toPROM	149	119
Link & Locate ++	395	329
Link & Locate ++ Extended	479	389

FORTRAN LANGUAGE

	LIST	OURS
FORWARN	329	295
FORTRAN DEV. TOOLS	129	116
Lahey F77L	595	535
Lahey Personal FORTRAN 77	99	89
MS FORTRAN	450	299
SALFORD FTN 77/ix	CALL	CALL
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GRAPHICS LIBRARIES

	LIST	OURS
Baby Driver	250	199
Essential Graphics	399	339
Font-Tools	150	119
Graf/Drive Plus Developer's	299	269
GrafPrint Developer's	300	265
GrafPrint for Graphoria	95	85
Network version	250	225
GrafPrint Personal	75	69
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graphics-MENU	179	159
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graphics-MENU Data Entry	99	89
w/source	224	199
GSS Graphics Devel. Toolkit	795	685
GX Graphics	149	135
HALO	395	279
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Menuet	325	279
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PCX Effects	99	89
PCX Programmer's Toolkit	195	175
PCX Text	149	135
SilverPaint	129	109
Stork, The	175	159

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	LIST	OURS
Super Pro-Pak	899	809
Turbo Geometry Library	200	179
Z-PHIGS Lite	199	179
Z-PHIGS Professional	799	699

LINKERS/LIBRARIANS

	LIST	OURS
Blinker	189	175
Overlay Toolkit	395	369
Plink86+	395	335
Plink/LTO	495	419
PolyLibrarian	249	209
.RTLink	295	265
.RTLink/Plus	495	359

OBJECT-ORIENTED TOOLS

	LIST	OURS
Objective-C	249	225
Smalltalk/V	100	85
Smalltalk/V 286	200	169

OS/2 TOOLS

	LIST	OURS
Brief	249	CALL
CASE:PM for C or C++	1995	1799
Epsilon	195	159
MKS LEX & YACC	349	279
MS OS/2 Pres. Manager Toolkit	500	349
MultiScope for OS/2	449	345
PCYACC	695	625
PI Editor	249	225
Smalltalk/V PM	495	369
Vitamin C (OS/2)	495	399
Zortech C++ OS/2 Devel. Ed.	600	509

PASCAL LANGUAGE

	LIST	OURS
Asynch PLUS	149	115
B-tree Filer	125	109
MS QuickPASCAL	99	69
Object Professional	189	109
ObjectVision	400	CALL
Power Tools PLUS/5.0	149	109
Topaz	99	89
Topaz Multi-user	149	135
Turbo Analyst	129	99
TurboMAGIC	199	179
Turbo Pascal 6.0	150	105
Turbo Pascal 6.0 Professional	300	205
Turbo-Plus 5.5	199	159
Turbo Professional 5.0	125	109

PROTOTYPING

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The Tandon NB 386sx Notebook: Saving Power When You Have Little to Spare

When I got my desktop SX two years ago, I thought it was a whole lot of power in a compact case. Today, I carried home a Tandon system with exactly the same power but now in a 6½-pound box the size of a 2-inch-thick notepad.

The **Tandon NB 386sx Notebook** system has a 20-/8-MHz 386SX processor and comes with a 3½-inch 1.44-megabyte floppy disk drive, a 30-MB Intelligent Drive Electronics hard disk drive, and 2 MB of RAM. You can increase memory by adding (80-nanosecond) 1-MB single inline memory modules, for a total of 16 MB. The 80-key QWERTY keyboard has a numeric keypad, or you can opt to add your own full-size PS/2 or AT keyboard. The system also comes with a VGA connector; two nine-pin serial ports, for a mouse, a modem, or other serial devices; a 25-pin parallel port, for a printer or other parallel device; and a system extension connector, for optional expansion boxes. DOS 4.0 and Windows 3.0 are included with the system.



The 9-inch monitor is a nonglare cold-cathode fluorescent tube, backlit, paper-white VGA (640 by 480 pixels) with 32 shades of gray. It's also downward-compatible with CGA, EGA, and MDA.

The system comes with a removable, rechargeable nickel-cadmium battery pack and an AC power adapter that charges the battery while it's attached to the computer. The auto-sensing AC adapter accepts 90 to 265 volts AC. The battery is good for about 3 hours under most conditions, and it recharges in about 3 hours.

The adapter has two LED indicator lights. The green light shows you're plugged into a power source. The red light shows it's charging the battery, and if there's a problem, it flashes red. There's the usual audible beep when the battery starts to run low. You can charge the battery when the system is on if you put it into suspend mode.

The Tandon NB 386sx Notebook has no real surprises. Its power-conservation technology is similar to that of the Texas Instruments Travel-Mate 3000. The Tandon has three levels of power conservation. The simplest is suspend mode, which you activate with the suspend/resume button—letting you shut down power, even for a minute, to save battery life whenever possible. Pressing any key brings you right back to where you left off. That's pretty straightforward and almost along the lines of a screen blanker.

Doze mode and sleep mode conserve more power yet. These modes are not unique, however, because the Travel-Mate 3000 uses Traveling Software's Battery Watch and Battery Pro utilities to shift the system into various conserving modes. On the Tandon, doze mode reduces the CPU speed, making the system draw a little less power. And sleep mode shuts nearly everything down by putting all peripherals in their lowest active states and also reducing the CPU speed. In your setup program, you choose how much time you want to leave the system idle before one or more of these features kicks in. Setting the interval at zero minutes keeps the features from activating.

Another feature that I liked is the ability to toggle specific keys and change the screen display font to boldface for easier reading. Of course, this isn't in the interest of power saving, but it does cut down on eyestrain.

This little machine comes with almost everything you need, but you can get an additional battery pack and auto-sensing power adapter, a fax modem, a system expansion box, an 80387SX math coprocessor, and more.

THE FACTS

Tandon NB 386sx Notebook
$3495

Tandon Corp.
405 Science Dr.
Moorpark, CA 93021
(800) 800-8850
(805) 523-0340
fax: (805) 529-8408
Circle 1168 on Inquiry Card.

The preproduction unit I tested was a standard system onto which I loaded Windows 3.0 along with all the other software I'm used to using on my desktop. It ran flawlessly. The only complaints I have are aesthetic. For example, the power switch isn't very obvious, but I found it. And the carrying case (which comes with it) carries nothing but the system, so I had to haul a paper bag under my arm with the AC adapter, mouse, cord, and some floppy disks, while the system itself stayed snug in the case over my shoulder. Not a great design for such a nice system. But, as I said, these are aesthetic complaints.

In the ever-widening league of SX notebooks, the Tandon's power-saving technology and general high quality put it in a class with the Travel-Mate 3000 and the Compaq LTE 386s/20. The TravelMate 3000, for example, costs $5499 and has only a 20-MB hard disk drive. The Compaq LTE 386s/20 has features similar to the Tandon's but costs a walloping $6499. From this perspective, Tandon moves to the head of the class when you compare features you get for the dollars spent.

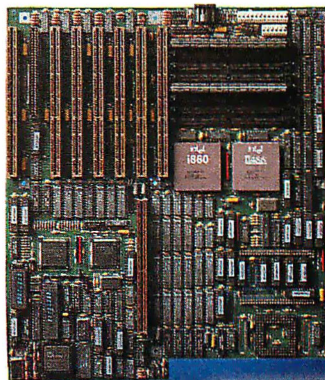
—Anne Fischer Lent

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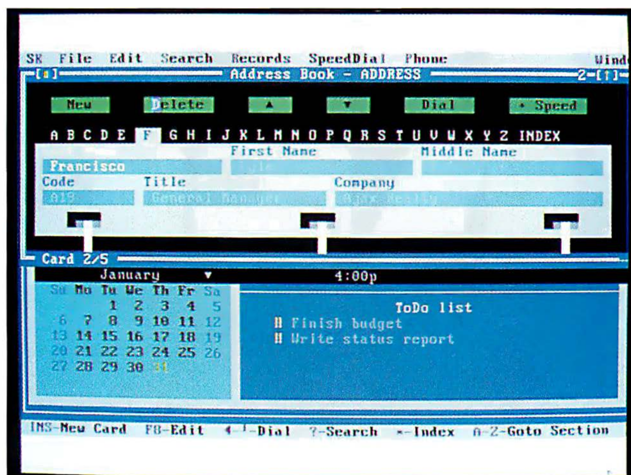
A New Version of SideKick Works with Paradox

It has been a while since Borland International upgraded SideKick, its premier TSR set of miscellaneous tools for the IBM PC. But the company has finally done it, and, based on an early look at the product, it seems a pretty good job has been done, too. Of course, if you have already made the switch to Windows 3.0, you might not need SideKick. But those who are still living in a speedy character-oriented world will find **SideKick 2.0** quite useful.

The first thing I noticed was that this new version of SideKick has a much improved user interface. Although it still lacks a real graphical user interface (GUI), the character-oriented windows and the pull-down menus are quick and fairly easy to use, even with a mouse.

Other improvements are more subtle: One is a smaller memory requirement. In TSR mode, the new SideKick takes up less than 40K bytes of precious main memory. If you can't spare even that small amount of memory, you can run SideKick as a nonresident program.

The individual applications in SideKick have a number of improvements as well. The notebook now has more printing capabilities, a spelling checker, and a thesaurus. The address book displays data in either a tabular or a simulated Rolodex-style card format. In addition, the calculator now features a wide range of mathematical and business functions.



THE FACTS

SideKick 2.0
$99.95

Requirements:
IBM PC-compatible system with a hard disk drive and 640K bytes of memory.

Borland International, Inc.
1800 Green Hills Rd.
P.O. Box 660001
Scotts Valley, CA 95067
(408) 438-8400
fax: (408) 439-9344

Circle 1169 on Inquiry Card.

SideKick now uses Paradox-compatible database files, made possible by using Borland's own Paradox engine. Data for SideKick's address book and appointment book is stored in files that can be accessed and modified by Paradox.

And thanks to the Paradox engine, SideKick now supports most networks. Several people can use the same address book or appointment book file at the same time. SideKick does periodic updates to the file to be sure that all users are looking at the same data.

SideKick now gives better support when you are traveling. If you don't have a laptop system, SideKick can print your address book and upcoming appointments in a nice typeset format, thanks to Bitstream fonts. And if you do have a laptop, you can take SideKick with you—provided you have at least a megabyte of disk storage available. When you return from a trip, SideKick has a new feature that lets you reconcile the laptop version of your appointment book with the version in your desktop system.

The only things lacking from the previous version, SideKick Plus, are the outlining and file management features. Outlining was probably not used very often, and the file management features seem to be usurped by the operating system.

SideKick 2.0 will be offered at a very reasonable price of $99.95. Chances are, however, that Borland will continue its policy of offering steep discounts to owners of other Borland products, which should result in an irresistible price.

Bottom line: There may be better programs for specialized needs, such as Act! for contact management. Some users may prefer a true GUI, in which case they may want to content themselves with the utilities in Windows 3.0. But everyone else—especially Paradox users—should find SideKick quite handy.

—*Rich Malloy*

Take A View into the Video World

At first blush, AView Technology's **DesktopTV** add-in board for PCs appears to be yet another product riding the wave of that latest computer buzzword: multimedia. After all, what else would you call an add-in that lets you display a TV picture on your computer monitor? But DesktopTV is a horse of a different color in the multimedia world. It lets you hot-key between your normal computer screen and a full-screen TV picture.

The differences come in several areas. For one, at $395, DesktopTV is downright inexpensive by multimedia standards. Other boards that display TV on a computer screen cost thousands of dollars. More important, DesktopTV is a TV display system only. It doesn't digitize the TV picture; instead, it simply passes along a pure analog signal that your monitor displays on the screen. That means that you can't display the picture in a

Add HP NewWave to Windows and what do you get? Simply a breakthrough.

Windows 3.0 is a great step forward. It just doesn't go far enough. You still have to overcome barriers you thought you'd left behind. Such as DOS. The complexities of file management and application integration. And working in two environments.

The solution? Simply add HP NewWave. In this one simple step, you turn your PC into the most powerful, easiest-to-use information tool in business. To prove it, we've put an eye-opening, interactive demonstration on disk.

It shows how NewWave's simple object model lets you work on one desktop, instead of having to use both the Program and File Managers. You don't have to understand the DOS file system at all. And it works with the Windows applications you already have.

Integrating these applications is astoundingly simple. Just drag and drop. "Drill down" editing lets you make changes in part of a document, such as a chart, without leaving it. And with "hot links," your data changes automatically in all connected files.

Our state-of-the-art interactive demo disk makes it easy for you to evaluate NewWave. Call **(408) 376-2727** for your copy (handling charge $3.95). Then experience one of the most dramatic breakthroughs ever brought to your screen.



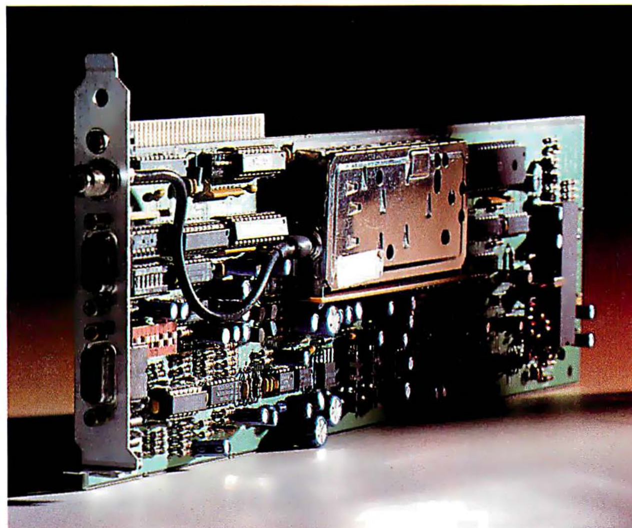
HEWLETT PACKARD

window, capture it, or manipulate it in any way.

That simple display capability isn't as big a problem as it might appear, especially for the customers that AView envisions will be purchasing the board. They see it as a "convenience" solution for people who spend lots of time in front of a computer and need occasional video updates. For example, workers can watch training videotapes or tune into the video conferences or the companywide broadcasts that some large corporations distribute to their employees.

Then, too, there's that elusive "home office" market. And it is handy. I do most of my writing at home and often have a TV on behind me as background noise. With DesktopTV installed in my computer, I could monitor the sound with the small external speaker that's shipped with the board and hot-key directly to the picture whenever I heard something of interest. (Late-breaking news, of course.)

DesktopTV works in conjunction with your existing computer graphics card (EGA or VGA) and connects between it and your monitor. I plugged in the external speaker, a coaxial cable connected to the local cable TV franchise, and ran a setup program. The one caveat is that the board I tested required a multisync monitor capable of supporting 15.7 kHz (CGA resolution). Those monitors are not that common these days, and I finally had to borrow an NEC MultiSync 3D. (A version of DesktopTV that supports any VGA monitor should be available by the time you read this.)



THE FACTS

DesktopTV
$395

Requirements:
IBM XT, AT, or compatible with a free 8-bit slot and a multisync color monitor supporting 15.7 kHz.

AView Technology, Inc.
2401 North Forest Rd.
P.O. Box 50
Buffalo, NY 14226
(800) 866-7288
fax: (716) 636-9327
Circle 1170 on Inquiry Card.

The setup program installs a TSR program for normal DOS use, as well as a utility program that switches from within Windows 3.0. The program also sets the initial color, brightness, and contrast levels. (The controls on the monitor have little effect on the TV picture.)

When I pressed the hot key after completing installation, the first thing that popped up was a screen that let me tune any of 119 channels, as well as set the speaker volume. I could change the preset brightness, contrast, and color levels. I could then hot-key between my work and the TV.

The picture is surprisingly sharp, with crisper colors than with a normal TV receiver. There's even a mute key that turns the speaker off if you're interrupted by the telephone (or if someone walks in). I expected that there would be interference on the screen because of the large amount of RF energy that the board puts out. But there was none; AView has heavily shielded the TV circuitry on the board.

If you're interested in true-blue multimedia capabilities, DesktopTV won't be for you. But for the more mundane uses it's aimed at, the product is an inexpensive solution. Then, too, I have to admit that it's an amusing diversion.

—Stan Miastkowski

Form Follows Function with Persuasion

When you're making a business presentation these days, Magic Markers and overhead transparencies just don't cut it any more. Not only does your audience expect a colorful three-dimensional presentation with special effects, your audience probably demands it. But what if you have only a few hours to spare from your busy day to create that presentation?

Using a preliminary version of Aldus **Persuasion 2.0**, I created in less than 2 hours a presentation that included multiple slides with organizational charts, bar charts, pie graphs, and speaker and handout notes. Just for fun, I added transitional wipe and fade special effects.

What makes the process go so quickly is Persuasion's predesigned slide and overhead templates. The program provides about 60 AutoTemplates that you use as a model for your presentation. You can create your own templates and mix different templates in the same presentation, if you are feeling particularly creative. The program also lets you modify an existing template by opening a copy of the one you want to adapt, making a few changes, and saving it as a new template. Templates take the ideas that you enter in basic text and transform them into slides that remain consistent throughout the presentation.

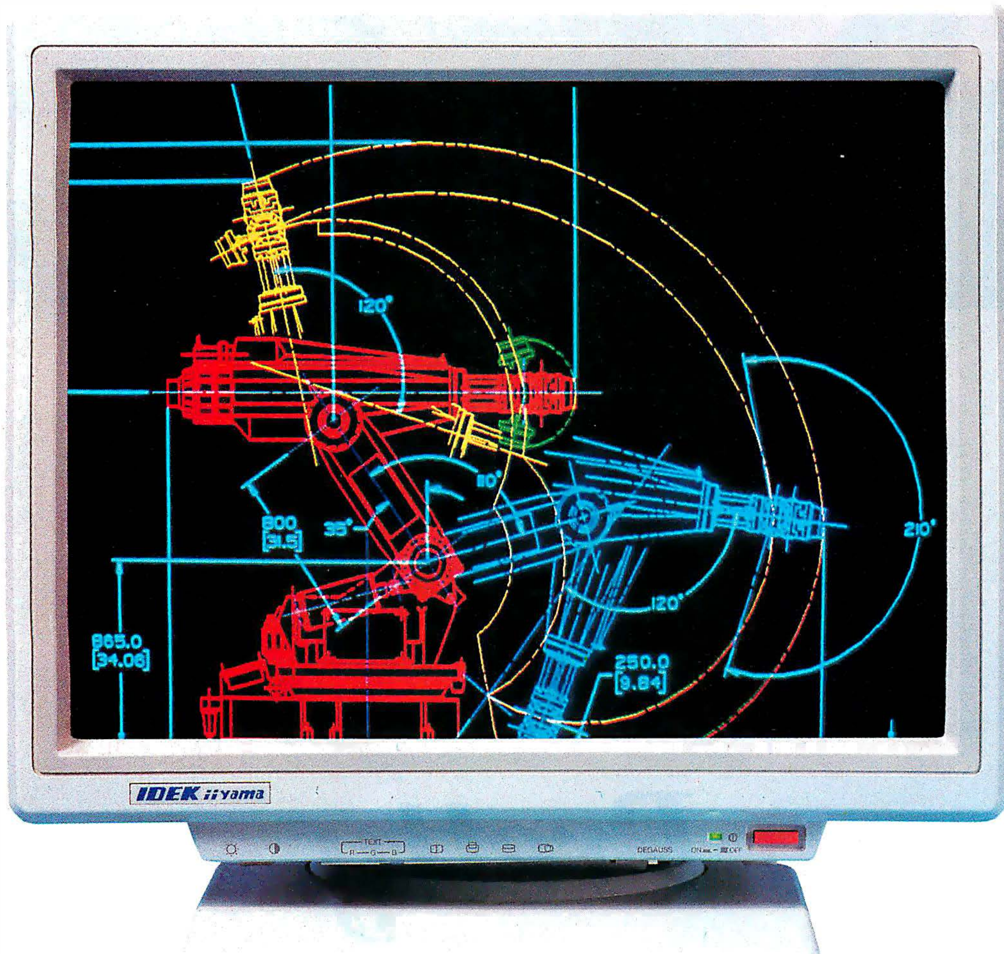
The best way to create the presentation is to start in the Outline view. As you type the main ideas of your presentation in the outliner, it may appear that you're dealing with text only. But behind the scenes, you're also preparing slides.

Using a combination of the Enter, Shift, and Tab keys in the Outline view, you create the text for each new slide or overhead. The program keeps a running tab in the left margin of how many slides you have in the presentation. If you want to view the slide from the Outline view, you just click on its number in the margin.

continued

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Neumannstrasse 38, 6000 Frankfurt a.M. 50, West Germany
Phone: (49) 69-521 922 Fax: (49) 69-521 927

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650 Louis Drive, Suite 120, Warminster, PA 18974 U.S.A.
Phone: (1) 215-957-6543 Fax: (1) 215-957-6551

Circle 137 on Inquiry Card.





Pretty.



Mission Critical Workstation 1448: 9 option slots and 2 drive bays.

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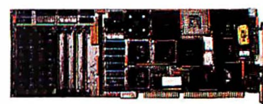
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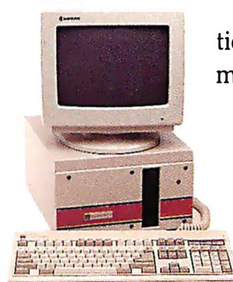
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Mission Critical Benchtop 2003: 10 option slots and 2 drive bays.



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Mission Critical Rack-mount 2001: 10 option slots and 3 drive bays.

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Maximized MTBF	Yes	No	No
Positive pressure, filtration	Yes	No	No
Operation at 55°C/131°F	Yes	No	No
48-hour burn-in at 55°C/131°F	Yes	No	No
Maximum expansion slots available	14	5	5
1-year, on-site warranty	Yes	No	No
Toll-free support number	Yes	No	No
Regional sales support	Yes	No	No
"Shake, rattle and roll" testing	Yes	No	No

For technical or sales information, call

1-800-627-8700



Texas Microsystems, Inc.

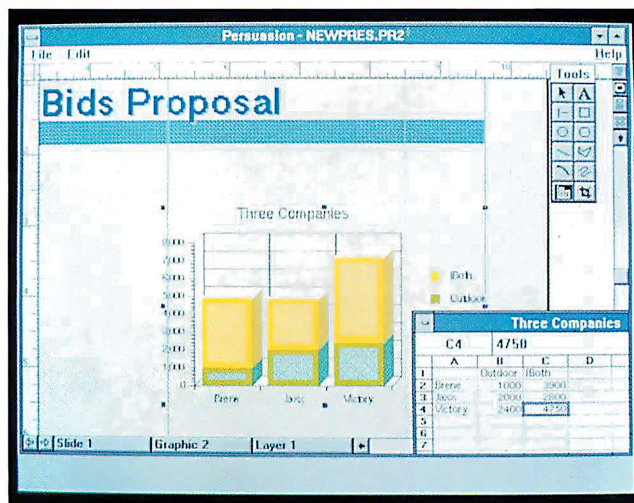
Circle 288 on Inquiry Card.

Once you're finished with the outline, you're ready to view the slides or overheads. You can look at thumbnail sketches of all the slides or overheads in the presentation or full-scale images of each. If you rearrange a slide while in Slide Sorter view, the change is automatically reflected in the outline.

In 30 minutes, I created a set of slides with nicely formatted text. All this is well and good, but some things are best said with a chart or graph, and this is where Persuasion really helps.

When in Outline view, I changed a text unit into a chart unit by highlighting the title and choosing "Chart" from the Outline menu. Two boxes appear: One looks like a standard spreadsheet, and the other is the chart information dialog box. You type or import the numbers in the former, select the type of chart that you want in the latter, click "OK," and presto, you can view a chart with tick marks, value labels, and other attributes.

As long as you use the same template, you can create as many charts as you desire without having to double-check that they use consistent fonts, point sizes, labels, and other formatting concerns. You just plug in the numbers and chart type; Persuasion does the rest. Of course, you can always create your own chart format.



THE FACTS

Persuasion 2.0
$595

Requirements:
IBM AT, PS/2, or compatible with 1 MB of RAM, EGA, and a mouse. A 386-based system with 2 MB of RAM and VGA is recommended.

Aldus Corp.
411 First Ave. S
Seattle, WA 98104
(206) 622-5500
fax: (206) 343-4240
Circle 1171 on Inquiry Card.

Once you've created your presentation images, you can print overhead transparencies or, using a service bureau or desktop film recorder, 35mm slides. To incorporate special effects, you'll probably want to create a desktop presentation. The program provides a variety of transitional special effects (e.g., dissolve, blinds, glitter, and curtains). You can apply a transition effect to an individual slide, or you can apply it globally. You can set up the presentation to run manually or automatically, with each image staying on-screen for as long as you specify.

To help prevent an embarrassing typographical error from appearing in full living color in front of 200 people, the program includes a spelling checker with search and replace capabilities. You can create speaker notes that include a miniature picture of each slide with notes that you type or import.

If you're working in Windows and need to create a presentation, I recommend Persuasion 2.0. Standing in front of a roomful of people is nerve-racking enough. With Persuasion, you can spend less time worrying about format and more time concentrating on content.

—David Andrews

A Mirror into Bigger and Cleaner Windows

As I see it, one of the biggest problems with Windows 3.0 (not to mention other graphical user interfaces) is that on your garden-variety VGA monitor, you get the uneasy feeling that you're looking through a peephole at a very small portion of a much wider world. Even a high-resolution monitor doesn't help much. Mirror Technologies' **PixelView PC** changes that, opening up a huge and eminently more usable desktop.

PixelView PC's package consists of a 20-inch monochrome monitor and a 16-bit add-in card customized for the monitor. The image on the screen is a sharp 1280 by 960 pixels, and because it's noninterlaced, it's rock steady. Add the 66-Hz refresh rate, and there's nary a hint of noticeable flicker. With an effective screen resolution of 91 dots per inch, those familiar Microsoft windows are surprisingly sharp. I had to get very close to the monitor before I was able to see the individual dots.

I had the initial impression that black-and-white windows would be bothersome, but that wasn't the case at all. The high resolution and the humongous desktop made using it an absolute pleasure. Of course, it helped that the unit I reviewed was the top-of-the-line 4-bit system that displays 16 shades of gray. (PixelView PC is also available in a 1-bit version that's plain-vanilla black and white.) I could display two full pages of text or graphics at the same time, and there's a "virtual desktop" that allowed me to create a desktop that's twice the size of the screen.

Installation is a breeze. Besides plugging in the board and hooking up the monitor, the only other chore needed is to install some software and (of course) a special driver using Windows 3.0's Setup utility. PixelView PC also comes with high-resolution drivers for AutoCAD, Ventura Publisher, GEM, WordPerfect, Word 5.0, and OS/2 Presentation Manager.

The 4-bit unit that I tested had full monochrome VGA support and sells for $1797. The two lower-end units (1-bit) both come with ($1297) and without ($997) Hercules emulation. All units use the

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Hours: Mon-Thrus: 8:30-7:00, Fri: 8:30-5:30 ET
Se Habla Espanol



Hitachi HD63484 graphics processor and a megabyte of video RAM. This takes the graphics processing chore away from your main CPU and results in a fast (0.25 second) screen redraw. That's about twice the speed of a standard VGA card, and (not surprisingly) this results in a real performance plus for graphics- and text-based applications.

When you consider that full-page monitors with capabilities like these often tip the budget scales with prices in the $3000–$4000 range, Mirror's prices on PixelView PC are surprisingly low. There's a simple explanation for this: Mirror sells directly to customers. This eliminates the extra markup that takes place in the manufacturer-distributor-dealer marketplace.

This represents the company's first foray beyond the Macintosh market, where it has earned a solid reputation for quality and 24-hour toll-free customer support. Mirror even offers a 30-day "love-it-or-return-it" policy. PixelView PC is truly innovative, the first affordable large-screen monitor system. With it, Windows 3.0 actually becomes a useful tool.

—Stan Miastkowski



THE FACTS

PixelView PC
1-bit system, $997; with Hercules emulation, $1297; 4-bit system with VGA emulation, $1797

Requirements:
IBM AT or compatible with a free 16-bit ISA slot.

Mirror Technologies
2644 Patton Rd.
Roseville, MN 55113
(800) 654-5294
(612) 633-4450
fax: (612) 633-3136
Circle 1172 on Inquiry Card.

Thermal Printing Takes to the Road with the WSP-200

Computer Products Plus calls the **WSP-200** the world's smallest printer, but qualifies it by saying it's the smallest one that prints a full page. To be exact, it's only 1⅛ by 6¾ by 11½ inches—so small that it fits inside a carrying case *with* my notebook computer. And it weighs just 3½ pounds, bringing the grand total weight of my computer and printer to less than 10 pounds.

The WSP-200 uses cut-sheet or rolls of thermal (fax) paper and prints both text and graphics bidirectionally. It prints pica at 28 characters per second, elite at 33 cps, condensed at about 50 cps, and enlarged at 15 cps. It uses an Epson LQ driver and also prints international characters. It's simpler to use than most high-end dot-matrix printers, and the output is far easier to read than most faxes.

To meet your on-the-road needs, the printer comes with both an AC adapter and a rechargeable nickel-cadmium battery with a rated life of 90 minutes and recharge time of 12 to 16 hours. It also comes with a Centronics-compatible interface connector for attaching to your parallel port on a portable or desktop system.

Indicator lights on the front include Paper Out, On Line, and Power. The battery case, also on the front, swivels forward and lets you simply slide the battery into position.

The WSP-200 is from a company that calls itself the "armorer to road warriors" and claims to be totally committed to those people who travel with computers and other electronic devices. As it comes from a company with such a creed, I shouldn't be surprised by so much quality in so small a box—but I am, and I continue to be amazed by all the tiny gadgets that let us simulate our office desktops while on the go. ■

—Anne Fischer Lent



THE FACTS

WSP-200
$399.95

Computer Products Plus, Inc.
16351 Gothard St.
Huntington Beach, CA 92647
(714) 847-1799
fax: (714) 848-6850
Circle 1173 on Inquiry Card.

"...simply stunning and incredibly fast!"

"highly recommended" by John Dvorak, Inside Track, PC Magazine, Nov. 13, 1990

PC Magazine's
Editors' Personal Best 1990

Byte's
Best Products of 1990, Award of Merit

PC World's
Best Buys in Windows Hardware Optimal Workstation

Here's what the experts are saying about the hottest high performance graphics board available – the Hercules Graphics Station Card™!

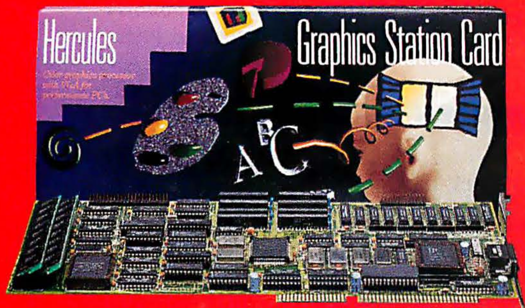
"At $1,024, the Hercules Graphics Station Card is state of the art at an exceptional price."
InfoWorld, Hercules' 34010 Graphics Board is State of the Art, Eric Azinger, Sept. 3, 1990

"...1024 x 768 non-interlaced 256 colour mode is the only way Windows should ever be run."
Personal Computer World, Guy Swarbrick, Hercules Graphics Station Card, June 1990, UK

"If you do a lot of different kinds of graphics but don't want to spend too much, the Graphics Station Card is for you. Highly recommended."
CADalyst, Ralph Grabowski, August 1990

"The Hercules Graphics Station Card combines an extraordinary set of features designed to handle your most...well...*Herculean* graphics tasks."
PC Magazine, Tom Unger, Best of 1990, January 15, 1991

"...Hercules will have proved, twice, that you don't have to be IBM to set standards."
Personal Computer World, Guy Swarbrick, Hercules Graphics Station Card, June 1990, UK



Hercules Graphics Station Card

For Windows, CAD, DTP and Color!

- Up to 1024 x 768 resolution
- 8, 16, 24 bit color*
- TI 34010 processor-60MHz
- Built-in VGA for compatibility
- 1 megabyte VRAM
- 2 megabytes DRAM *(Model GB1024+2)*
- Includes TIGA 2.0, Microsoft Windows 3.0 (256 colors) and ADI 4.0/4.1 drivers

To find out where you can buy your Hercules Graphics Station Card, call **800 532-0600, ext. 745.**

For People With High Standards!



Circle 131 on Inquiry Card.

NEWS

HARDWARE • SYSTEMS

Four Notebooks to Take Note Of

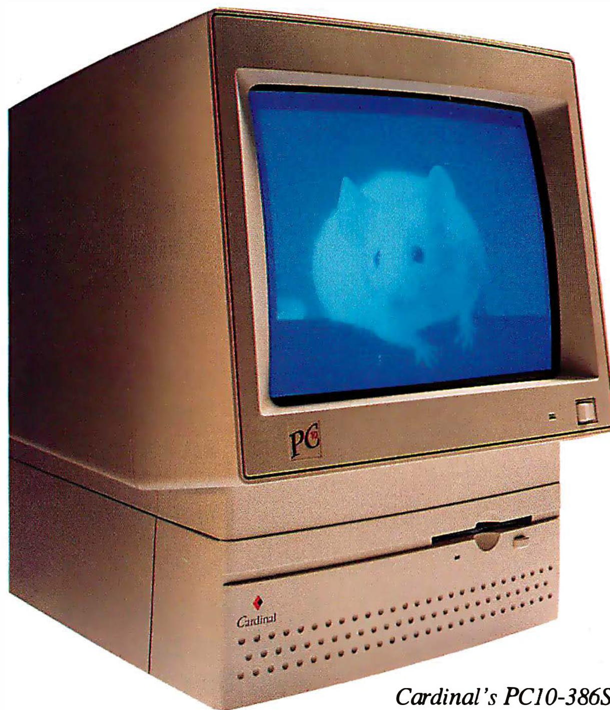
Astarte, Austin, and AST have recently introduced notebook computers that deserve a serious look.

Astarte's 386SX Quest features integrated telecommunications, including a built-in phone, voice record/playback, and simultaneous two-line fax/modem capabilities. Quest's standard configuration includes Keymouse (an integrated pointing device), the ability to use standard C batteries in addition to its nickel-cadmium battery pack, and a SCSI port interface.

The system comes with 2 MB of RAM, a 20-MB hard disk drive, a 3½-inch floppy disk drive, a parallel port, a serial port, and a VGA backlit screen.
Price: $3950.
Contact: Astarte Computer Systems, Inc., 1035 Pearl St., Fifth Floor, Boulder, CO 80302, (303) 449-9970; fax (303) 449-2773.
Circle 1287 on Inquiry Card.

The 386/SX-20 and 286/12 systems from Austin both have a 3½-inch floppy disk drive and a 20-MB hard disk drive in a 2-inch-thick chassis. The 386/SX-20 has 2 MB of RAM (expandable to 4 MB), and the 286/12 has 1 MB of RAM (expandable to 3 MB). Both computers have a 10-inch diagonal backlit LCD VGA screen, a VGA monitor port, a printer port, two serial ports, and a modem/fax slot. Included with both machines are suspend/resume and sleep modes, a video/audio low-battery indicator, and an AC adapter.
Price: 386/SX-20, $2690; 286/12, $1890.
Contact: Austin Computer Systems, 10300 Metric Blvd., Austin, TX 78758, (512) 339-7932; fax (512) 454-1357.
Circle 1288 on Inquiry Card.

AST's Premium Exec 386SX/20 features 2 MB of RAM (expandable to 8 MB), VGA capability, a 3½-inch floppy disk drive, one serial port, one parallel port, and support for an 80387SX numeric coprocessor. The Model 23V has a 20-MB hard disk drive, and the Model 43V has a 40-MB hard disk drive. The backlit film supertwist LCD provides a black-on-white or white-on-black image. The Premium Exec runs on nickel-cadmium batteries. It also has a system backup battery and a built-in temperature monitor.
Price: Model 23V, $2995; Model 43V, $3395.
Contact: AST Research, Inc., 16215 Alton Pkwy., P.O. Box 19658, Irvine, CA 92713, (714) 727-4141; fax (714) 727-9355.
Circle 1289 on Inquiry Card.



Cardinal's PC10-386SX needs only a single cord to power up.

A Compact PC with Built-in Features

A plug-and-play, fully integrated personal computer has been introduced by Cardinal Technologies. The 20-MHz PC10-386SX has a 12-inch VGA monitor, 1 MB of RAM (expandable to 8 MB), and EMS 4.0 support. Besides one parallel port, two serial ports, and a mouse port, the system has two ISA-compatible expansion slots. It comes with the DR DOS 5.0 operating system, a graphical user interface, built-in VGA graphics, and a 3½-inch floppy disk drive.
Price: $999; with 40-MB hard disk drive, $1399.
Contact: Cardinal Technologies, Inc., 1827 Freedom Rd., Lancaster, PA 17601, (800) 233-0187 or (717) 293-3000.
Circle 1291 on Inquiry Card.

Modularity in an EISA Portable PC

The Dolch-P.A.C. 486-33E EISA-based portable computer runs at 33 MHz with 32-bit bus channel and bus-master capability. The portable is modularly expandable via four internal slots. The Back-P.A.C. expansion chassis is available if you need additional expansion.

The P.A.C. 486-33E has a high-contrast electroluminescent yellow-on-gray display. Its two VGA-compatible display options—VGA red plasma and VGA thin-film-transistor color—can emulate all lower display standards. The video systems can drive external color monitors while providing an image on its internal screen.

The P.A.C. 486-33E has 2 MB of RAM (expandable to 32 MB), a 100-MB hard disk drive, and a 5¼- or 3½-inch floppy disk drive.
Price: Basic configuration, $15,995.
Contact: Dolch Computer Systems, 372 Turquoise St., Milpitas, CA 95035, (800) 538-7506, (800) 233-2077 in California, or (408) 957-6575; fax (408) 263-6305.
Circle 1290 on Inquiry Card.

PostScript Printing Paradise

Three printers provide a range of Adobe PostScript printing capability.

The JetScript-CX laser printer from the Printer Works uses QMS's JetScript controller card and Canon's LPB-CX engine. Designed to work with PCs, the printer includes 3 MB of RAM, a Motorola 68000 16-MHz processor, and an Adobe PostScript interpreter with 35 scalable fonts.

The JetScript-CX runs under DOS, Windows 3.0, and Novell NetWare. It also supports any application that can print to an Apple LaserWriter Plus.

Price: $995 with a refurbished engine; $1295 with a new engine.

Contact: The Printer Works, 3481 Arden Rd., Hayward, CA 94545, (800) 235-6116, (800) 225-6116 in California, or (415) 887-6116.

Circle 1292 on Inquiry Card.

A multiuser laser printer from Dataproducts, the LZR 660 incorporates PostScript Level 2 software and a Weitek RISC processor. The printer provides forms handling, graphical pattern support, and new halftoning algorithms.

The LZR 660 prints 6 pages per minute and measures 1⅓ square feet. With a duty cycle of 3000 pages per month, the LZR 660 has interfaces for AppleTalk/RS-422, RS-232C, and Centronics. Its SCSI port supports an optional external hard disk drive.

Price: $2995.

Contact: Dataproducts Corp., 6200 Canoga Ave., Woodland Hills, CA 91367, (800) 624-8999 or (818) 887-8000; fax (818) 716-6486.

Circle 1293 on Inquiry Card.

From Seiko Instruments comes the 300-dpi ColorPoint PS for PCs, Macs, or Unix systems. This PostScript-compatible color printer uses an Intel 80960 RISC microprocessor and prints in up to four colors.

The ColorPoint PS prints images of 8.53 by 13 inches and 11.73 by 17.12 inches to provide full-page bleeds on standard and tabloid-size paper. The printer's Plug n' Play Plus feature automatically scans four of its five communication ports and begins printing the first available data.

Price: Model 4 (letter size), $6999; Model 14 (tabloid size), $9999.

Contact: Seiko Instruments USA, Inc., 1130 Ringwood Court, San Jose, CA 95131, (408) 922-5800; fax (408) 922-5840.

Circle 1294 on Inquiry Card.



Chinon's DS-3000 color scanner also scans 3-D objects.

Scan in Color Under Windows 3.0

The PC-compatible DS-3000 desktop color scanner from Chinon America runs under Windows 3.0. It can scan full-color images and 3-D objects in 4096 colors or 256 gray levels. The scanner comes with a color converter, Colorset scanning software, a scanner cable, and an AC adapter.

Price: $995; color add-on package for black-and-white scanners, $395.

Contact: Chinon America, Inc., 660 Maple Ave., Torrance, CA 90503, (213) 533-0274; fax (213) 533-1727.

Circle 1296 on Inquiry Card.

Signs from a Desktop Plotter

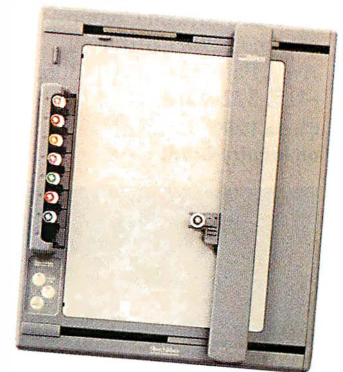
SketchMate, a desktop plotter that you can convert into a sign-making machine, operates with PC Hewlett-Packard Graphics Language–compatible software programs. In addition to sign making, the machine supports CAD, business presentation, graphic design, and training applications.

As a plotter, SketchMate supports eight broad- or thin-tipped pens in a choice of 32 colors. It uses a variety of media, including multipurpose bond paper and matte film. As a sign maker, the machine lets you create signs, labels, and logos with a cutting pen that cuts through vinyl or flock.

Price: $695.

Contact: Roland Digital Group, 1961 McGaw Ave., Irvine, CA 92714, (714) 975-0560; fax (714) 975-0569.

Circle 1295 on Inquiry Card.



SketchMate, more than a desktop plotter, converts easily into a sign-making machine.

Speed in a Single-Board Computer

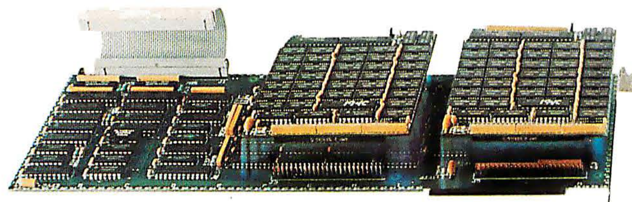
Silicon Composers is offering a single-board computer with a program execution speed of from 10 to 15 MIPS at 8 MHz (with burst speeds of between 50 and 60 MIPS) for standalone operation or embedded systems control. Designed at Johns Hopkins University's Applied Physics Lab, the SC/FOX SBC32 is based on the SC32 Stack Chip CMOS microprocessor.

The SBC32 uses the SC/Forth32 interactive language and includes a 56,000-bps RS-232C serial port, a reset switch, 128K bytes of shadow RAM, and 64K bytes of zero-wait-state static RAM (expandable to 512K bytes at 10 or 12 MHz). Included with the board are SC/Forth32, an MS-DOS shell editor, and an MS-DOS I/O utility.

Price: 8-MHz system: introductory price until May 30 for BYTE readers, $995; thereafter, $1495.

Contact: Silicon Composers, Inc., 208 California Ave., Palo Alto, CA 94306, (415) 322-8763.

Circle 1297 on Inquiry Card.



A Convertible Controller from DPT

The SmartCache Plus cache-convertible controller's modularity lets it grow to fit your needs. From Distributed Processing Technology, the basic ISA or EISA card offers bus mastering with full SCSI disk and device compatibility. Using DPT emulation technology, the controller works under all PC operating systems. Add-on modules include a cache module with an initial 512K bytes of cache RAM, 2-MB and 4-MB memory modules, and a mirroring module. A 4-MB expansion card is also available. The controller uses a 68000 CPU, a 16-bit SCSI protocol controller chip, and DPT custom application-specific IC chips.

Price: $595 and up.

Contact: Distributed Processing Technology, 140 Candace Dr., Maitland, FL 32751, (407) 830-5522; fax (407) 260-5366.

Circle 1301 on Inquiry Card.

A Colorful Board

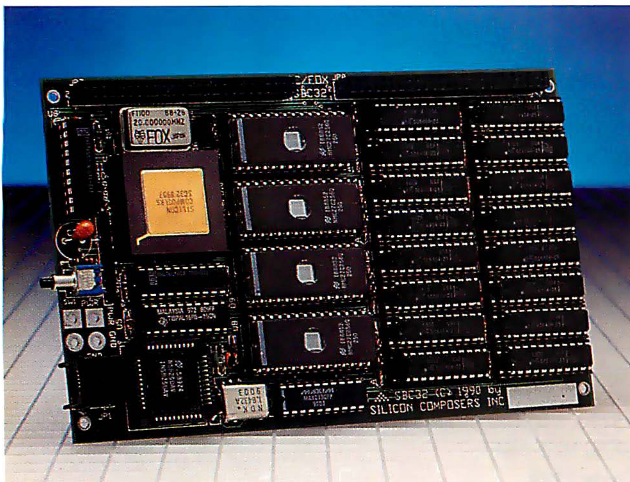
The RVGA III adapter from Appian Technology uses a Tseng Labs ET4000 graphics controller and provides a 70-Hz refresh rate. The board, part of Appian's Renaissance line, is register-level compatible with VGA, EGA, CGA, MDA, and Hercules video graphics standards.

Configured with from 512K bytes to 1 MB of DRAM, the RVGA III displays up to 1024- by 768-pixel noninterlaced resolution. It supports 16 or 256 simultaneous colors or shades of gray from a palette of 256,000 colors and includes an IBM VGA bidirectional feature connector.

Price: $349.

Contact: Appian Technology, Inc., Cedar Park, 2265 116th Ave. NE, Bellevue, WA 98004, (206) 646-0710; fax (206) 462-5640.

Circle 1298 on Inquiry Card.



The SC/FOX SBC32 computer uses the SC32 Stack Chip microprocessor, which executes the Forth language in silicon.

Newer (and Faster) SIMMs

Newer Technology's 16-MB composite single in-line memory modules use 70-ns RAM for quick data access. The units, which have the industry-standard 30-pin construction, appear to the operating system as true 16-MB increments to ensure compatibility. Available for PCs and Macs, the SIMMs are useful for memory-intensive applications such as graphics imaging and multiuser systems.

Price: $1950.

Contact: Newer Technology, 7803 East Osie, Suite 105, Wichita, KS 67207, (316) 685-4904.

Circle 1299 on Inquiry Card.

Get the Big Picture on Your Mac Classic

A clip-on video board that provides large-screen viewing for the Mac Classic is available from Mirror Technologies. The board, which supports Mirror's PixelView single- or dual-page monochrome displays, attaches to the 68000 processor on the Classic's motherboard. The cables from the board exit through the Classic's security port.

The board is packaged with PixelView I, a 15-inch monitor with a 75-Hz refresh rate, or with PixelView II, a 19-inch monitor with a WYSIWYG display and 78-Hz refresh rate. Both systems include Mirror's Desktop Designer utility.

Price: PixelView I, $567; PixelView II, $897.

Contact: Mirror Technologies, 2644 Patton Rd., Roseville, MN 55113, (612) 633-4450; fax (612) 633-3136.

Circle 1300 on Inquiry Card.

db_VISTA III for Windows 3.0™

The DBMS That Opens Windows™

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No Other DBMS Opens Windows Like db_VISTA III!

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- **C Source Code Available.** For total programming flexibility.
- **Portability.** db_VISTA III supports most environments.

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Database Management System

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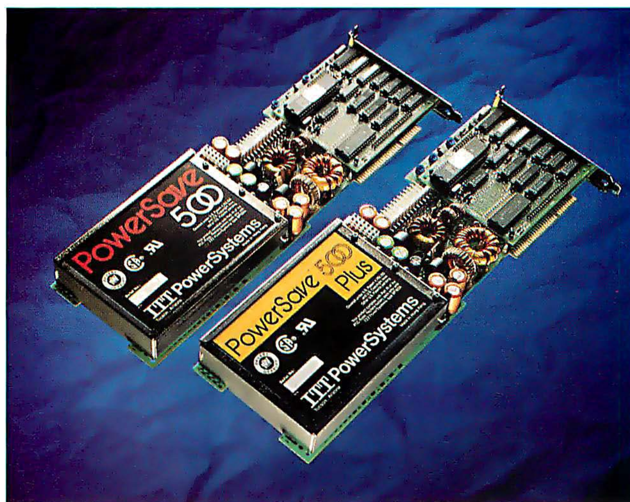
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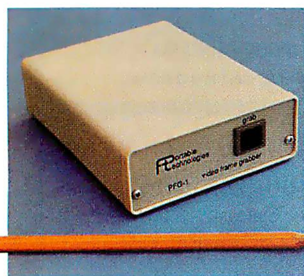
Power Without Interruption

VIP PowerSave 500 Plus from ITT PowerSystems is an uninterruptible power supply for 386 and 486 systems operating under most expanded and extended memory modes. It is a more powerful version of the VIP PowerSave 500, which the company has reduced in price.

When a power interruption occurs, PowerSave 500 Plus immediately provides backup power, automatically saves a complete image of the PC state to disk, and shuts down the entire system. After power is restored, the device automatically restores the computer's state.
Price: VIP PowerSave 500 Plus, $299; VIP PowerSave 500, $249.
Contact: ITT PowerSystems Corp., 3400 East Britannia Dr., Tucson, AZ 85706, (602) 889-7600.
Circle 1302 on Inquiry Card.



VIP PowerSave 500 Plus does its work automatically.



Grab a Video Frame Where You Find It

A portable video frame grabber is available from Portable Technologies. The battery-powered PFG-1 can digitize and store a video frame in 1/60 second.

The PFG-1 provides an image with a resolution of 320 by 200 pixels with 64 levels of gray. It can grab frames without being connected to a computer and transfer a stored image to any computer that has an RS-232C serial interface. You can adjust the image displayed on-screen for brightness and contrast and print it directly to Hewlett-Packard LaserJet II and compatible printers. It operates on a 9-V lithium battery.
Price: $269.
Contact: Portable Technologies, P.O. Box 20763, Castro Valley, CA 94546, (415) 537-4954.
Circle 1303 on Inquiry Card.

View VGA Color Through Optically Coated Glass

Fellowes has an optically coated glass antiglare filter for use with high-resolution VGA color monitors. The optical coating, which is on both sides of the filter, reduces glare from the terminal and from surrounding lights, while increasing the contrast of the monitor. You attach the antiglare screen to the top of the terminal with clips that you secure with Velcro.
Price: $59.95.
Contact: Fellowes Manufacturing Co., 1789 Norwood Ave., Itasca, IL 60173, (708) 893-1600.
Circle 1304 on Inquiry Card.

An Expandable Population of Fonts

Type City from Bitstream offers expandability in a cartridge. In addition to an expandable-base cartridge, the Type City system includes low-cost add-on fonts and screen fonts for Windows users. The cartridge comes with 1 MB of text and display fonts on the base.

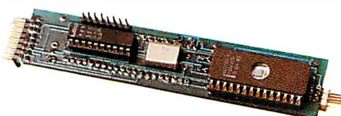
To expand Type City, you insert credit-card-size fonts into slots on the side of the cartridge. You can customize the cartridge with typefaces of your choice, including logos, symbols, and signatures.

Type City runs on all Hewlett-Packard LaserJet Series II and III printers and full cartridge compatibles. It requires a PC with a minimum of 512K bytes of RAM. A starter kit includes the base cartridge, a Deli add-on card, screen fronts, and a template book.
Price: Starter kit, $379; add-on cards, $99 and $129.
Contact: Bitstream, Inc., 215 First St., Cambridge, MA 02142, (617) 497-6222; fax (617) 868-0784.
Circle 1305 on Inquiry Card.

Computer on a Stick

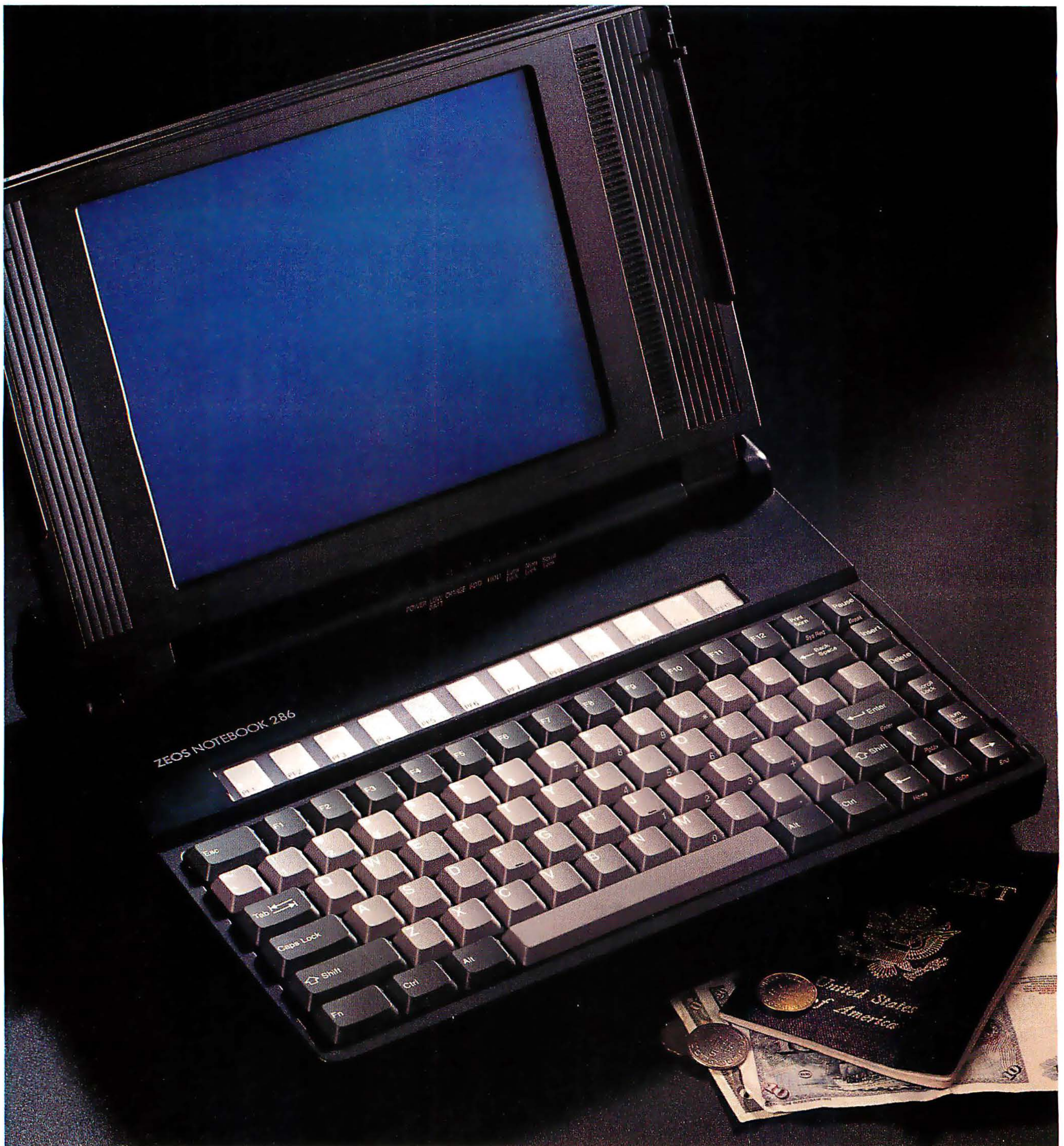
The Datastick One personal controller lets you do computer work in places a portable PC wouldn't dare to go. Just 4¾ by 1 inch, this programmable computer uses add-on modules to control or measure a variety of environments.

After you have attached the appropriate modules to the Datastick, you run the Datastick Connection software on your PC with the Datastick connected to your PC's serial port. Disconnecting the Datastick triggers it to function as programmed. Datastick applications include bar code reading, light-level control, atmospheric reading, machine diagnosis, and acceleration reading. The Datastick executes programs while it's connected or disconnected from your computer. When you reconnect the Datastick to your PC, the collected data is transferred and is ready for direct field analysis.
Price: $245.
Contact: Langley Autosystems, P.O. Box 64591, Sunnyvale, CA 94086, (408) 773-8368.
Circle 1306 on Inquiry Card.


DataStick One

The New ZEOS®

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Notebook.

'286 Only $1995!

"A NEW KING OF THE HILL"—PC MAGAZINE

PC MAGAZINE SAID IT BEST.

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Everything. As they said, the Zeos Notebook "offers a top notch combination of power, weight, features and price..." In short, everything you're going to appreciate in your new ZEOS notebook.



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For instance, the battery system of your new notebook is the most advanced on the market. You can quick charge, or trickle charge, any time your system is plugged in. Or, you can use the optional charging stand if you wish.

Either way, you're sure to appreciate our light weight snap-in, snap-out battery packs. They're so light and easy to use, you can easily take an extra one with you on those really long trips. Plus, you can get even more life out of a single charge by using our programmable power management system. Hour upon hour of Notebook computing power!

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Your new ZEOS notebook is a great connectivity tool! Using our optional built-in 2400 baud MNP Class 5 modem, connectivity buffs will find themselves logging on at every turn.

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Circle 327 on Inquiry Card.

A Diagnostic Cable Scanner

A hand-held LAN diagnostic tool that runs on a single 9-V battery, Quick Scanner from Microtest is completely menu driven. It uses time-domain reflectometry as it automatically scans the cable to pinpoint the location of a problem.

You don't need any technical knowledge or training to operate Quick Scanner. You simply turn on the unit, plug in the LAN cable, and press Enter. The scanner displays the location of the fault in normal English.

Quick Scanner (measuring 7½ by 4 by 1 inch and weighing 1 pound) comes as a kit that includes the scanner, a quick-test plug, and a battery. The unit is also able to monitor traffic on Ethernet networks, and adapters are available to enable operation on most twisted-pair and coaxial cables.

Price: $995.
Contact: Microtest, Inc., 3519 East Shea Blvd., Suite 134, Phoenix, AZ 85028, (602) 971-6464; fax (602) 971-6963.
Circle 1307 on Inquiry Card.

Intuitive Communications Program

The first product from a new company, Eclin Connect 1.0 brings an easy-to-use intuitive communications program to the casual PC user, according to Eclin Technology. A combination of basic functions for the beginner and advanced capabilities that Eclin says are easily learned, the program is available at an introductory price of $49. Users of Procomm Plus, Smartcom, Crosstalk, Mirror, and PC-Talk can purchase Eclin Connect for $29 as an upgrade.

Features include point-and-shoot menus, mouse support, an integrated text editor, background file transfers, and a script language with a script recorder and debugger. With the text editor, you can send text directly to a remote system or printer without first creating a disk file. Eclin Connect runs entirely in text mode on all DOS computers.

Price: $49; upgrade from specified programs, $29.
Contact: Eclin Technology, P.O. Box 2041, Trenton, NJ 08607, (609) 393-0577; fax (609) 393-1990.
Circle 1308 on Inquiry Card.

A Server with Assets

The ACScript multipurpose server enables HP LaserJet and compatible printers to connect directly to LANs. Also, a printer can mix PostScript and PCL printing in a single document, merge forms on-line, provide print spooling and storage to its hard disk drive, and print two-sided pages in PostScript. Housed in a tower, the server comes in four configurations. The basic unit has three input ports, a 20-MB hard disk drive, and 4 MB of memory. The top-of-the-line unit has five input ports, 8 MB of memory, and an 80-MB hard disk drive. The 35 internal fonts in each configuration match the standard fonts of the Apple LaserWriter Plus.



Price: $2795 to $4895.
Contact: Applied Computer Sciences, Inc., 11711 North-creek Pkwy. S, Suite 107, Bothell, WA 98011, (800) 525-5512 or (206) 486-2722; fax (206) 485-4776.
Circle 1311 on Inquiry Card.

Link Up Your Computer

A peer-to-peer, entry-level network operating system called ReadyLink is available from Compex. Geared for small and medium-size businesses, ReadyLink is compatible with most standard ARCnet, Ethernet, and Token Ring adapter cards that have a Novell NetWare driver.

ReadyLink can support from two to 20 users. The system is NetBIOS compatible and supports IBM PCs and compatibles.

Price: Software only, $299; two-user starter kit, $499; additional users, $99 each.
Contact: Compex, Inc., 4055 East La Palma, Unit C, Anaheim, CA 92807, (714) 630-7302; fax (714) 630-6521.
Circle 1309 on Inquiry Card.

Long-Distance Power-Up for Your Computer

TeleSwitch lets you remotely power your computer and other electronic devices on or off via a telephone or modem. You plug your system and peripherals into the unit, and it's ready to go at the sound of your call. TeleSwitch, which uses solid-state surge-clamping electronic circuitry and a time-delay circuit, comes in two models: the basic 300 and the 400, which adds Touch-Tone security access.

Price: TeleSwitch 300, $299; TeleSwitch 400, $499.
Contact: EKD Computer Corp., 770 Middle Country Rd., P.O. Box Y, Selden, NY 11784, (800) 468-6353 or (516) 736-0500; fax (516) 736-2209.
Circle 1310 on Inquiry Card.

SPEED. GUARANTEED.



Here's a chance to buy our $99 Math Coprocessor at no risk whatsoever! It's fully guaranteed to at least double the math performance of your software.

If you want to unlock the full power of your PC, pick up the phone and order an AMD 80C287 math coprocessor. Without it, your PC just isn't really complete. You see, our math coprocessor can *dramatically* increase the performance of 1-2-3,® dBASE,® Excel, and hundreds of your other favorite business applications! It actually runs calculations *two to ten times faster* than your PC can *without* a math coprocessor. Which means your graphs will draw incredibly fast and your spreadsheets will recalculate at truly blazing speeds. (And that's just for starters!)

High speed at a low price.

Don't think you have to pay over $200 for a math coprocessor. Now you can get ours for just $99 when you order direct from AMD! The AMD 80C287 is fully compatible with your 80286-based PC and the hundreds of commercially available software packages written for it. Our coprocessor is also compatible with the Intel NMOS 80287.

Installation is a snap.

The AMD 80C287 plugs easily into a socket that's already inside your 80286-based PC. In fact, you can be up and running in just five minutes. Simply plug the chip into the socket and watch the dazzling improvement in performance! The AMD 80C287 comes with easy-to-follow installation instructions, a free utilities disk (which includes diagnostics and test software), and free color computer games.

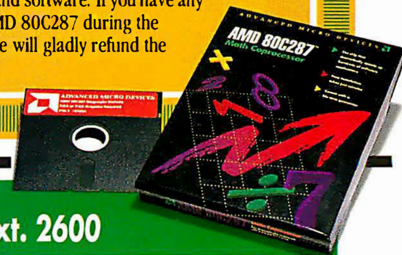
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Guarantee #2: If your AMD 80C287 Math Coprocessor ever fails to perform for any reason, AMD will replace it free of charge, no questions asked. Limited to two lifetime replacements per person.
Guarantee #3: AMD guarantees that the AMD 80C287 is fully compatible with your 80286-based hardware and software. If you have any compatibility problems with the AMD 80C287 during the first year, return the product and we will gladly refund the purchase price.



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Adobe's ATM
QEMM 5.1
Logitech Mouse

SAVE $881

"The Brick is... a great personal computer in every respect. It takes up minimal desk space, it's both rugged and stylish, and it's extremely fast."

Bill Machrone, **PC Magazine**, 1/91



Fits in half a briefcase, leaving room for full-sized folders, notebooks, etc.

system, video and hard disk benchmarks.

Massive Hard Disk

Bricks are available with 16 or 20 MHz 386SX, 1-8 MB of RAM, a fast 44, 104 or 212 MB Conner or Teac IDE hard disk, and a 387 coprocessor socket. A 2,400 bps Hayes compatible modem is standard.

"A whole new slant on portable computing... exceptionally ingenious."
Portable Office
12/90, Eric Grevstad

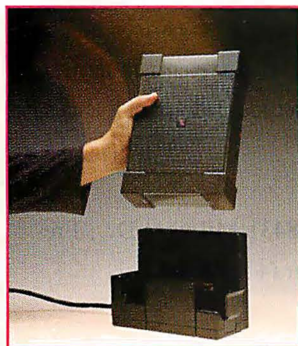
"Recommended."
Jerry Pourmelle **Byte**, 1/91,

The fast VGA graphics feature up to 1024 x 768 non interlaced resolution with a full 1 MB of video memory. In fact, the Brick's video performance is twice as fast as the average of 42 386SX systems tested to date by *PC Magazine!*

Surprisingly Expandable

The Brick is only about the size of a ream of copier paper, yet you can still add up to two ISA half cards internally, (one card with a floppy drive). A docking port allows easy, drop-in connection to our Docking Terminal, **$349**, which instantly hooks up all cables and provides another 16-bit 3/4 length slot. The "Stretch" version of the Brick accomodates full length cards.

"A Tote-able That Outperforms the Desktops."
PC Magazine
9/90, Matt Ross



Brick & Windows Hot Special

It takes more than just software and a mouse to make a satisfying Windows machine. Our Brick & Windows Special comes with 4 MB of RAM (not 2 as others provide), Windows 3.0, DOS, and a Logitech mouse with our hot 16 MHz 386SX Brick. You also get two award winning programs that are essential to fulfilling the promise of Windows. Adobe's wonderful Type Manager (ATM) with 13 fonts for true WYSIWYG display and high quality printed documents and Quarterdeck's QEMM 5.1 memory manager for running Windows on a network.

No other 386SX matches the Brick's graphics processing power, storage capacity, quietness and versatility. And while others give you Windows, we give you what it takes to make Windows 3.0 really perform.

$2,495

Brick & Windows Special includes:

- ▲ 16 MHz Intel 386SX
- ▲ 4 MB RAM
- ▲ 44 MB 28ms hard disk
- ▲ 1024 x 768 VGA adapter
- ▲ 2,400 bps modem
- ▲ 3.5" floppy
- ▲ 16-bit half card exp. slot
- ▲ 1 parallel, 2 serial ports
- ▲ Windows 3.0 and DOS
- ▲ QEMM 5.1
- ▲ Adobe Type Manager
- ▲ Logitech Mouse
- ▲ All software completely set up. Ready to go.

Options:

- ▲ 104 MB add **$395**
- ▲ 212 MB add **$995**
- ▲ 20 MHz Brick add **$250**
- ▲ 8 MB RAM add **$396**
- ▲ 12" mono VGA monitor & 101 keyboard add **$218**
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Circle 106 on Inquiry Card.

A Full Meal for File Sharers

Nexsys Electronics' Soup to Nuts Network Bundle contains the hardware and software necessary for peer-to-peer file sharing among 10 or more Macs and multiple LaserWriters. Soup to Nuts consists of 10 Intellinet connectors and a 24-node license for Everyware's allShare 1.1 file servers. Each connector is compatible with AppleTalk, PhoneNet, and Flashtalk and includes a 10-foot phone cord and a terminating resistor.
Price: $399; $16 per additional connector if purchased within one year of the kit.
Contact: Nexsys Electronics, 667 Folsom St., San Francisco, CA 94107, (800) 541-9981 or (415) 541-9980: fax (415) 541-9984.
Circle 1312 on Inquiry Card.

A Mini Transceiver for Network Connection

Lancast's ETP-4310 Twisted-Pair Mini-Transceiver's seven diagnostic LEDs and full transceiver operation let users connect their PCs, servers, and workstations into a 10Base-T–compliant twisted-pair Ethernet network. Known as a mini-twister, the ETP-4310 can detect and correct for reversed polarity of the receive twisted-pair wiring.

You attach the unit directly to the standard 15-pin AUI D connector on your computer or terminal equipment. A standard telephone connector provides the interface for the twisted-pair network wiring. The transceiver drives the signals to any twisted-pair hub device that complies with the 10Base-T standard.

The mini-twister includes switch-selectable signal-quality error and link test functions. These functions let you configure operation for a variety of applications.
Price: $160.
Contact: Lancast, 10 Northern Blvd., Unit 5, Amherst, NH 03031, (603) 880-1833; fax (603) 881-9888.
Circle 1313 on Inquiry Card.



The Stepcube features tool-less device installation through its access panels.

Step Up to Versatility

The Everex Stepcube, a 12-slot 486/33 EISA computer system, incorporates the Everex Thermal Management System, which uses two SmartFans to route air through the chassis: One fan cools the system board and expansion cards, and the other cools the power supply and drives. Designed for use as a file server, multiuser system, or graphics workstation, the 12-slot board is expandable (eight-slot 386 and 486 versions are also available). Removable side panels let you access the system without using a screwdriver. The cube is stackable, so you can install two systems in a minimum space. Security features include side-panel access locks and password protection.
Price: $9000 to $14,000.
Contact: Everex Systems, Inc., 48431 Milmont Dr., Fremont, CA 94538, (800) 356-4283 or (415) 498-1111.
Circle 1316 on Inquiry Card.

Take RISC with Your Controller

RIO, a RISC-based distributed I/O controller for multiuser PC Unix systems with up to 512 users, permits more than 80 feet between the host PC and remote terminal adapters when you use conventional cabling. With fiber-optic cabling, you extend the distance to about 1¼ miles.

The modular RIO system uses Inmos parallel processors, which allow each RIO card to support up to 128 users. Custom communication processors by Cirrus Logic replace the usual universal asynchronous receiver/transmitters. The RIO's reconfiguration software lets you move remote terminal adapters and their associated workgroups without disturbing users on the system.
Price: 32-port system, $3540; 128-port system, $12,660.
Contact: Specialix, Inc., 985 University Ave., Suite 12, Los Gatos, CA 95030, (408) 354-4498; fax (408) 354-7178.
Circle 1314 on Inquiry Card.

Communicate from Your Poqet

Poqet Computer has introduced a 2400-bps, pocket-size modem for its Poqet PC. Measuring 4 by 1 by 2⅖ inches and weighing 6½ ounces, the Poqet/WorldPort 2400 operates for up to 10 hours on a 9-V alkaline battery.
Price: $345.
Contact: Poqet Computer Corp., 555 North Mary Ave., Sunnyvale, CA 94086, (408) 737-8100; fax (408) 739-5589.
Circle 1315 on Inquiry Card.



CARRY-I

The New Standard

The Carry-I 9000 series comes complete with 80386SX/80286-16/ 80286-12 microprocessor (Co-Processor optional). 1024 × 768 VGA/MGA & CGA display interface, 1/2/4 MB RAM, one 3.5" 1.44 MB FDD or one FDD plus one 40/80 MB HDD, one 8 bit expansion SL●T, one parallel and two serial I/O ports, and one 30W auto range switching power adapter, all in the traditional 240mm × 185mm × 45mm (9.4" × 7.3" × 1.8") casing of Carry-I. Each package includes two mini-tower stands and a carry bag. The 81 key mini keyboard with 101 functions and 9 inch color or monochrome VGA monitor are optional.

Other Carry-I products include the 8000 series XT & AT book-size personal computers and the 6000 series XT and AT book-size LANstations. All Carry-I product lines are bundled with DR D●S 5.0



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Circle 118 on Inquiry Card (RESELLERS: 119).

Interface Builder for OSF/Motif

You can now extend the Xbuild OSF/Motif interface builder by adding your own widgets and resources to satisfy corporate standards and customize applications. According to Siemens Nixdorf, interfaces generated with Xbuild 1.1 are run-time independent and do not require additional run-time software libraries or license fees.

Using the WYSIWYG editor, you can create interfaces that use Motif graphical objects. A test mode lets you test your work at any stage in the creation process. To make the tool simpler for programmers working on a specific project, you can remove Xbuild widgets that do not relate to an application.

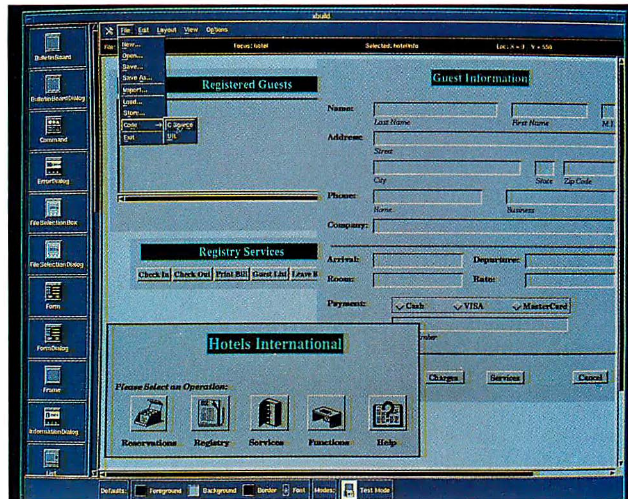
Xbuild 1.1 can import User Interface Language (UIL) code, allowing you to use it on an existing program. Xbuild generates C (ANSI or Kernighan & Ritchie) code or OSF UIL code.

The tool runs on Sun-3, Sparcstation, 386 SCO/Open Desktop, DECstation 3100, MIPS, and Siemens workstations running Unix System V 3.2 or 4.3 with OSF/Motif.

Price: $5000; internal use license, $1500; binary license, $1895.

Contact: Siemens Nixdorf Information Systems, Inc., 200 Wheeler Rd., Burlington, MA 01803, (617) 273-0480; fax (617) 221-0231.

Circle 1271 on Inquiry Card.



Xbuild, which includes a WYSIWYG graphical editor, object base, and code generator, was used to build this front end to a hotel reservation system.

C Toolbox for DOS, Mac, and Sun

A new version of the C Programmer's Toolbox adds support for Microsoft C 6.0 and Symantec's Think C 4.0. The Toolbox also supports ANSI C, Borland Turbo C 1.x/2.x, and Sun's Unix C.

Version 2.1 of the toolbox supports Macintosh Programmers' Workshop, DOS, and Sun Unix development environments. CLint, a C source code semantic checker, now offers ANSI function prototype generation for any C source code and the construction of composite include files. New file/function interdependency reports added to the CFlow tool help determine the best way to organize a program for performance and segmented, overlaid, and virtual memory architecture considerations, the company says. New C Source code formatting options include input and output tab-size specification and in-line formatting.

Price: $125 to $495.

Contact: MMC AD Systems, P.O. Box 360845, Milpitas, CA 95036, (415) 770-0858; fax (415) 770-0116.

Circle 1272 on Inquiry Card.

Add Features to Applications

If you want to adapt existing programs to handle new features such as security, on-line help, or mouse support, one way is with a new DOS-based memory-resident programming language from Portable Computing Systems. Called Via, the language supports the retrofitting of applications with features the designer left out.

You can also use the language, which the company says resembles a combination of Pascal and BASIC, to create access to proprietary data files found in third-party applications.

Via requires 50K bytes of available RAM on a DOS-based system.

Price: $249.

Contact: Portable Computing Systems, Inc., P.O. Box 870755, Dallas, TX 75287, (800) 749-4917 or (214) 380-6686; fax (214) 380-6184.

Circle 1273 on Inquiry Card.

Momentum Breaks Down the IPC Walls

Momentum says the distributed version of XIPC frees you from design and coding complications when designing cooperative applications that use interprocess communications (IPC) to go beyond the "walls" of a single machine or operating system. XIPC extends the native IPC functionality of multitasking operating systems such as Unix, SunOS, OS/2, and pVMS without modifying the operating system kernel. The new version also supports AIX on the IBM RISC System/6000, Ultrix, and Windows 3.0.

XIPC offers a common application programming interface in the form of libraries and utilities. The XIPC model comprises two building blocks: tasks, such as Unix processes, OS/2 threads, and DOS/Windows programs; and objects, such as message queues, semaphores, and shared memory segments. Tasks communicate, synchronize, and share data with each other using IPC objects, whether on one platform or over a network, regardless of the task's location on the network, the task's operating system, or the mix of operating systems.

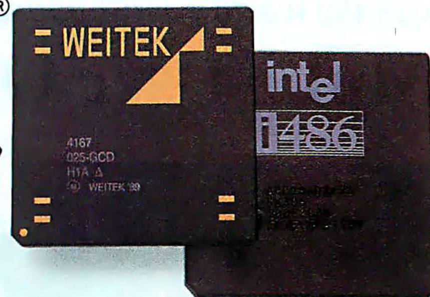
Price: $4000 and up.

Contact: Momentum Software Corp., 401 South Van Brunt St., Englewood, NJ 07631, (800) 767-1462 or (201) 871-0077; fax (201) 871-0807.

Circle 1274 on Inquiry Card.

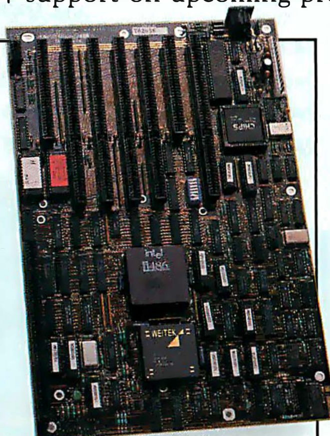
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The 4167's 10 MFLOPS performance delivers 3X the speed of the 486!

The new Weitek 4167 coprocessor outperforms the 486 by 3 to 1 in numeric processing. Capable of 10 MFLOPS, the 4167 has sockets in some of the most sophisticated 486 systems on the market, including Compaq, Intel, Hewlett-Packard, and Microway. The 4167 is object-code compatible with the WEITEK 3167 FPU and Microway's mW3167-PS add-in card for the MicroChannel—offering easy access to a broad base of existing CAD/CAM, scientific and engineering applications like Mathematica, CADKEY, HOOPS and Microway's NDP compilers. And look for 4167 support on upcoming products from Autodesk!



Number Smasher®-486 converts your old AT or 386 into a powerful 486 workstation. In a review of 25 MHz 486 motherboards, Mike George of *Personal Workstation* magazine wrote, "Microway's Number Smasher-486 gives you top 486 numeric performance for the best price...Number Smasher's numeric performance exceeds that of all 25 MHz 486 systems we've tested to date." Running the Microway Benchmark Suite, the 4167-equipped Number Smasher-486 achieves 11.9 MegaWhetstones. The board features a Burst Bus™ memory interface that makes it stand out in numeric problems that involve large arrays. Burst cycle response in a 486 system is much more important than second level caches, which are usually too small to be of any use on the megabyte arrays found in real world problems.



The ideal solution for numerically or I/O intensive applications is Microway's new Number Smasher-486/33T workstation. Two configurations are available, each incorporating state-of-the-art power and cooling with 300 to 600 megabyte drives.

NDP Fortran-486, NDP C-486 and NDP C++ are your keys to unlocking the power of the 4167. Each compiler generates globally optimized, mainframe quality code and has special features that take advantage of the 4167, such as register caching, loop unrolling and automatic inlining of small procedures. These optimizations are handed off to a code generator that is tuned for the 4167, and takes advantage of its advanced instructions like multiply accumulate. In addition, the 486 versions of NDP Fortran, C++ and C properly sequence 486 and 4167 instructions so that the 486's prefetch queue has time to "breathe." NDP compilers are also available for the 386SX, 386 and i860 under DOS, UNIX, XENIX and SunOS. Thousands of Microway's satisfied customers have discovered that you can't buy a better scientific Fortran or C compiler. And our technical support is the best in the industry.

For more information, please call 508-746-7341.

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The Major BBS® starter system:

A complete BBS software package for your PC, PS/2, XT, AT, 386, 486, or compatible. Includes electronic mail with binary and ASCII file "attachments", SIG conferencing or "forum" areas with configurable security level access control, file upload/download, message keyword searching, "quickscans" for fast access to new messages, message and file "threading", real-time multi-user "chat" and teleconferencing, "classified ad" and "user registry" databases, etc. Also includes accounting, Audit Trail, and timed usage-metering features, and hundreds of convenience features for the Sysop (System Operator), such as a full-screen configuration editor, the ability to import/export files to/from floppy without system shutdown, "SIG-Op" privilege delegation, and much more. Supports up to 2 simultaneous users (from a database of thousands) on a single CPU. Works with standard Hayes-compatible COM1/2/3/4 internal or external modems, or with serial ports up to 38,400 bps. Minimum RAM requirement 512K. Minimum disk requirement 20MB. Requires PC-DOS or MS-DOS 3.1 or later.

The Major BBS Standard Edition ..... $ 59

When you're ready to expand:

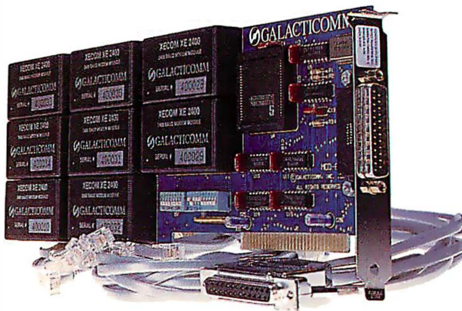
No LAN or multi-tasking OS necessary! Double the number of simultaneous users that your system can support, from 2 to 4, or 4 to 8, or any number up to 64 simultaneous users on a single CPU, for a flat $300 software license fee per doubling. The upgrade process is quick, automatic, and fully upward-compatible – i.e. you can install an update or upgrade onto your existing system without disrupting any of your user account files, E-Mail messages, configuration variables, or any other aspect of your system. For up to 16 users, 640K RAM is sufficient; above 16 users, more than 640K may be necessary. Prerequisite: The Major BBS (any edition).

Users, per doubling (up to 64) ...... $ 300

If you need multi-modem hardware:

Our Model 2408 consists of up to 8 Hayes-compatible modems on a single circuit card, for the PC/XT/AT/386/486 family. Each modem operates independently at 300/1200/2400 bps (automatically switching to match the caller's bps rate). Built-in serial ports are not COM-port based, so this card can co-exist with other COM port hardware in the same machine (drivers for software other than The Major BBS are not included but may be written). RJ-11 telephone cables are included. MNP Class 4 (error correction) modems are available as an option.

	non-MNP	MNP Class 4
2408 w/2 modems	$ 1536	$ 1696
2408 w/4 modems	$ 2090	$ 2388
2408 w/6 modems	$ 2644	$ 3080
2408 w/8 modems	$ 3198	$ 3772



When you're ready for source code:

With the C source code to The Major BBS, you can add 3rd-party software, such as The Major Database (a general-purpose, configurable database manager), various multi-player real-time adventure games, dial-out utilities, global command utilities, accounting enhancements, and much more. Also, you can maintain your own copy of the BBS, or you can modify it to suit your own unique requirements. The Major BBS C source code package is fully documented, and it includes the Galacticomm Software Breakthrough Library, plus all of the utility object libraries, linker control files, and DOS "batch" files you will need, along with a detailed Programmer's Guide. Works with Turbo C 1.5, 2.0, or 2.01, Turbo C++, or Microsoft C 4.0, 5.1, or 6.0. Prerequisite: The Major BBS Standard Edition.

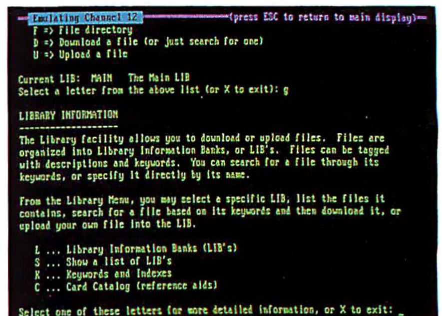


Standard Edition C source code ..... $ 285

For the ultimate in *file transfer flexibility:*

The File Library Edition of The Major BBS has everything that the starter system does, plus built-in ZMODEM, KERMIT, Super-KERMIT, YMODEM-g, and YMODEM (batch) file transfer protocols. Also, it offers super-fast pre-indexed keyword file searches, library-wide searches as well as constrained searches, special file upload/download accounting options, alternate DOS "paths" per sub-library, split paths for CD-ROM support, a transparent "DOS-only" sub-library option, and much more. This package is for you if the focus of your system will be the upload and download of large amounts of files. You can easily upgrade from the starter system to the File Library Edition, without losing any of your data files or configuration work you have already done. Prerequisite: The Major BBS Standard Edition.

File Library extensions .... $ 199
*File Library C source extensions** ... $ 159



If you decide to offer *online games and amusements:*

The Entertainment Edition of The Major BBS has everything that the starter system does, plus Quest for Magic (a multi-player interactive text adventure game), Androids! (a multi-player arcade-style ANSI-graphics game), Flash Attack (a futuristic tank and laser battle for multiple players with IBM PC's), and the Action Teleconference Link-Up, which includes private "chambers", action verbs (grin, wink, nudge, etc.), the ability to link to other systems for huge multi-system teleconferences, custom entry/exit strings, user-configurable profiles, and much more. This Edition supports the Flash™ Protocol (where most of the game functionality is on the user's

end of the phone line), for which dozens of incredible new multi-user games are now being developed. Upgrading from the starter system to the Entertainment Edition is quick



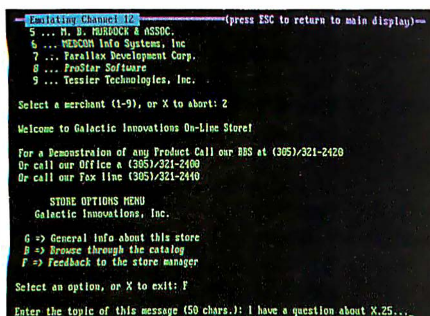
and easy and involves no loss of data or function. Prerequisite: The Major BBS Standard Edition.

Entertainment extensions .... $ 149
*Entertainment C source extensions** .. $ 129

If your requirements include *order entry and catalog sales:*

The Shopping Mall Edition of The Major BBS has everything that the starter system does, plus online shopping. Your online mall can have multiple "stores", each run by its own separate "merchant", if desired. Each merchant has control over his or her own product line, pricing, discount structure, store welcome message, sales tax handling, etc. Also, each merchant may create up to 6 different payment methods (e.g. VISA, MC, AMEX, C.O.D., "bill me", etc.), and up to 6 different shipping methods (e.g. UPS, FedEx, US Mail, etc.), each with its own rates (flat rate, percent of sale, 1st-ounce/add'l-ounce, or 1st-pound/add'l-pound). Users may browse product catalogs at no obligation, or order products and services directly online! Orders generate invoices that are posted to the individual merchant as attachments to E-Mail. To upgrade from the starter system to the Shopping Mall Edition takes only a few minutes. Prerequisite: The Major BBS Standard Edition.

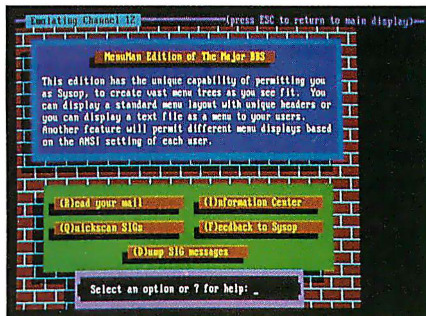
Shopping Mall extensions .... $ 249
*Shopping Mall C source extensions**. . $ 189



For super-flexibility of *menu trees and ANSI screens:*

The MenuMan Edition of The Major BBS can do everything that the starter system does, and in addition you as Sysop can create your own menu trees, with menus leading to menus leading to menus, as deeply "nested" as you like. The "leaves" of your menu trees can be ordinary ASCII or ANSI files, which are simply dumped to the user's display (with or without automatic screen breaks), or they can be any of the built-in functions of the BBS such as scanning the user's incoming E-Mail or firing up a SIG quickscan. Includes commands like *GO <pagename>*, *FIND <topic>*, *USERS*, and for the Sysop, the equivalent of the DOS commands *DIR*, *RENAME*, *COPY*, *DEL*, *MKDIR*, and *RMDIR*, as well as a set of privileged commands for editing and extending the menu trees, remotely, while the BBS remains fully online. Upgrading from the starter system to the MenuMan Edition takes only minutes. Prerequisite: The Major BBS Standard Edition.

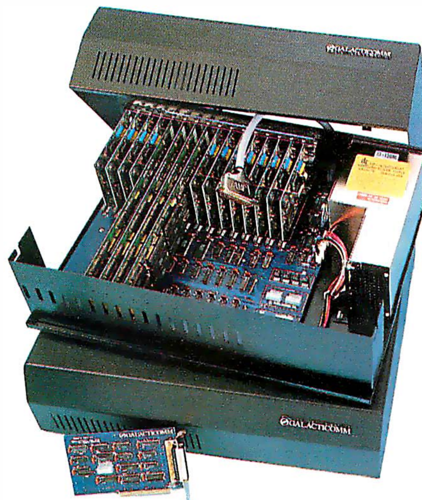
MenuMan extensions .... $ 149
*MenuMan C source extensions** .... $ 129



As your system grows larger...

The GalactiBox™ is our 16-slot "expansion chassis", for large-scale systems. It has the unique ability to address individual modems by slot number rather than just COM port address, so you can use up to 16 standard internal modems in it, side by side, without conflict. Includes built-in 150W power supply, interface card for your XT/AT/386/486, cables, and full documentation. Up to 4 boxes may be attached to one CPU, for a total of up to 64-channel expansion capacity. Prices shown below are for standard 300/1200/2400 bps Hayes-compatible internal modems. We also have 9600 bps V.32/V.42 MNP Class 5 modems available, call for prices.

GalactiBox (unpopulated) .... $ 1992
GalactiBox w/4 modems .... $ 2416
GalactiBox w/8 modems .... $ 2840
GalactiBox w/16 modems .... $ 3688



...and that's not all! For advanced applications, we also offer an X.25 direct-connect software option, a protected-mode development toolkit, and special licensing arrangements for up to 256 simultaneous users! And don't forget the smorgasbord of 3rd-party add-ons available, such as The Major Database from Galactic Innovations. Custom programming and integration services are also available. Your system can grow in power and sophistication, far into the future, with The Major BBS.

Here's How To Order:

Just dial (305) 583-5990 and say, "I'd like to place an order!" We can generally ship your order within 48 hours. We accept major credit cards, or we can ship C.O.D. Prices shown do not include shipping or insurance.

For more information, you may either call the main order number and ask for a sales engineer, or dial (305) 583-7808 with your modem (8-N-1) for a free demo of most of our products. This demo system also contains an online Shopping Mall with many of the 3rd-party add-ons available for The Major BBS, operated by the 3rd-party vendors themselves.

Give us a call today!







**The C source code extensions are necessary, if you wish to combine multiple extended Editions together, or add 3rd-party software, or develop your own modifications. Prerequisites, in each case, are the Standard Edition C source code, and the corresponding extended Edition.*

GALACTICOMM

Galacticomm, Inc. 4101 S.W. 47 Ave.
Suite 101, Fort Lauderdale, FL 33314

Modem: (305) 583-7808
Fax: (305) 583-7846
Voice: (305) 583-5990

Circle 122 on Inquiry Card.

NEWS

SOFTWARE • BUSINESS

Desktop Mapping for Mac and Windows

MapInfo's new version of its mapping and database software for Windows 3.0 is part of a strategy to provide versions of MapInfo for graphical user interface systems that can work together in mixed vendor environments. It uses an underlying relational database engine instead of requiring you to export data to a relational database.

MapInfo can transparently access data from files in dBASE, Lotus 1-2-3, Excel, and ASCII, the company says. The program also includes the ability to directly query Structured Query Language databases.

You can view data in three ways: a geographical view, a tabular format, or a graphical view. Data in these views is live and, if changed, will update immediately in the other windows.

Price: $995.

Contact: MapInfo Systems Corp., Hendrick Hudson Building, 200 Broadway, Troy, NY 12180, (800) 327-8627 or (518) 274-8673; fax (518) 274-0510.

Circle 1275 on Inquiry Card.

Tactician 2.0, a business mapping and planning tool for the Mac, can handle up to 9 million records at once, letting you convert a large customer database into a geographic display. The program currently supports the U.S. Dual Independent Map Encoding of the 1980 U.S. Census system (support for 1990 Census data will be available in the next few months). Tactician also works with MSA, DMA, Hospital, and similar databases.

Tactician 2.0 uses Apple's Data Access Language to access data stored on Structured Query Language–based databases. The program's Trade Area feature lets you retrieve data on an area that you specify simply by drawing a circle on a map. You can also view data in one window and a corresponding map in another.

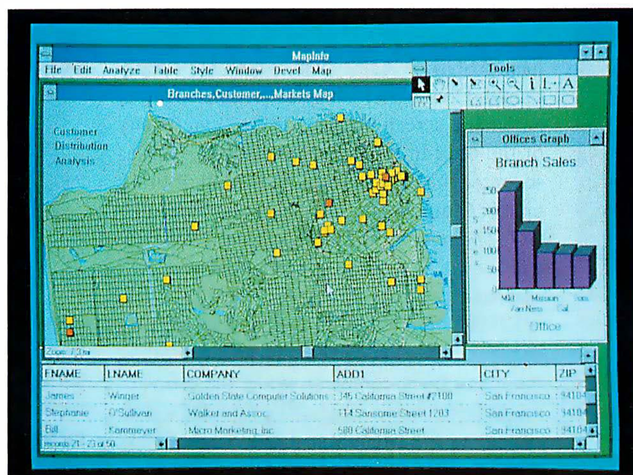
Two versions of the program are available. The base program includes maps of all states and counties, interstate highways, 8000 cities, 118,000 place names, ZIP code centroids, and four demographic and two business variables for each state and county. The high-resolution ZIP code version includes ZIP code boundaries for thematic mapping.

In addition to the Macintosh version, which requires a Mac II, the company is planning to release versions for Windows 3.0 and OS/2 Presentation Manager.

Price: Base Mac version, $995; high-resolution version, $3995.

Contact: Tactics International, Ltd., P.O. Box 4016 BV, 16 Haverhill St., Third Floor, Andover, MA 01810, (800) 927-7666 or (508) 475-4475; fax (508) 475-2136.

Circle 1276 on Inquiry Card.



MapInfo for Windows lets you view information on customers in geographical, tabular, and graphical format.

Database on Latin America

For organizations needing information about Central and South America, Info-South is an on-line database of articles that focus on economic, political, and social issues of both regions. Info-South consists of article abstracts drawn from more than 150 daily newspapers and weekly magazines and 1500 monthly and quarterly journals. It is available on a yearly or hourly subscription basis. If you can't get on-line, the company will perform searches on a specific topic ($25 per topic) and mail or fax a hard copy of abstracts that meet specified criteria. The company also stores each original document and can send copies on request.

Price: $800 per year; $85 per hour.

Contact: Info-South, Institute of Interamerican Studies, P.O. Box 248014, Coral Gables, FL 33124, (800) 752-9567 or (305) 284-4414; fax (305) 284-6370.

Circle 1277 on Inquiry Card.

Many Forms from One with JetForm

By supporting named pipes, the new Server portion of JetForm's family of forms-design, fill-in, preparation, filing, and printing products lets client processes come and go independently from the server. You can generate from one data-entry screen a variety of reports and forms for several departments and print them at multiple locations.

JetForm Merge lets you merge variable data from files created by a host application with electronic forms created with JetForm Design, a WYSIWYG forms designer that runs under Windows 3.0. The merge product also supports configurations in which end users can print forms and reports from dBASE, Lotus 1-2-3, or another application without seeing JetForm.

JetForm Merge is available for DOS, OS/2, Unix, and VAX platforms. For optimum printing speed, the company wrote its own printer drivers.

The company says it will support named pipes running on DOS-based Novell networks in the second quarter. The server version for LAN Server/LAN Manager runs as a server task. The server for DOS LANs requires a dedicated workstation.

Price: JetForm Designer, including a copy of JetForm Filler for Windows and character-based applications, $495; JetForm Filler, $199; JetForm Server for DOS, $1195; JetForm Server for OS/2, $1695.

Contact: JetForm Corp., P.O. Box 606, 163 Pioneer Dr., Leominster, MA 01453, (800) 267-9976 or (613) 594-3026; fax (613) 594-8886.

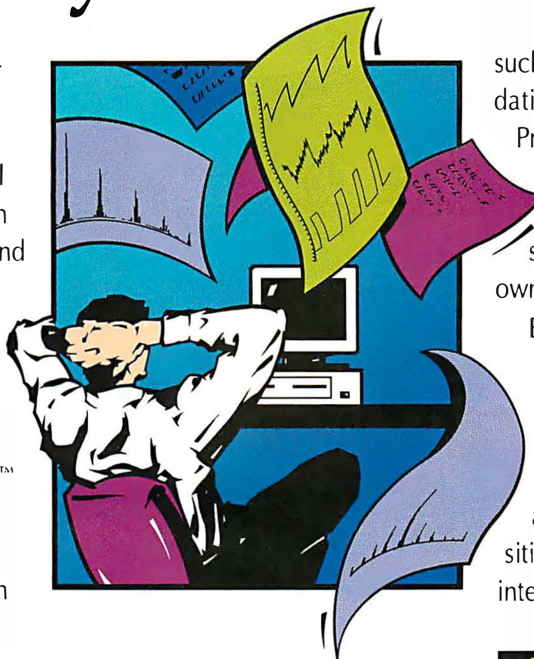
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INTELLIGENT DATA ACQUISITION SYSTEMS

Imagine what you can do with the development time you save.

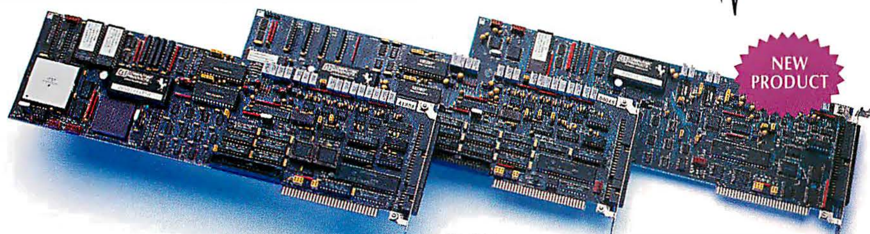
If your application is too demanding for a standard data acquisition package, you have just two choices. Spend valuable time writing low-level code. Or get a data acquisition system that provides its own microprocessor and control subsystem.

Microstar Laboratories' intelligent Data Acquisition Processors™ are complete control subsystems, not just hardware input/output units. The DAP 800,™ DAP 1200,™ and DAP 2400™ have on-board processors, buffer memory, and DAPL™—a complete real-time multitasking data acquisition and control operating system.



such tasks as writing to disk and updating the screen. The Data Acquisition Processors are compatible with C, Pascal, BASIC, FORTRAN, and other PC programming languages, so you can add code to meet your own specific needs.

By providing a second processor and separating the data acquisition operating system from the PC's operating system, the Data Acquisition Processor gives you a high performance data acquisition system for the price of a non-intelligent data acquisition board.



DAP 2400: The most powerful in the series, with digital signal processing.

DAP 1200: A general purpose workhorse for a variety of large applications.

DAP 800: A Data Acquisition Processor for the price of a non-intelligent board.

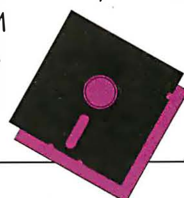
More than 100 Built-in Commands

DAPL provides more than 100 data acquisition processing commands—without programming. These include commands for averaging, scaling, peak detection, integration, thermocouple linearization, PID process control, event detection, digital filtering, and spectral analysis.

DAPL can be expanded without limit by downloading custom commands from the host PC.

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Each Microstar Laboratories system includes on-board RAM for buffering data while the PC is performing



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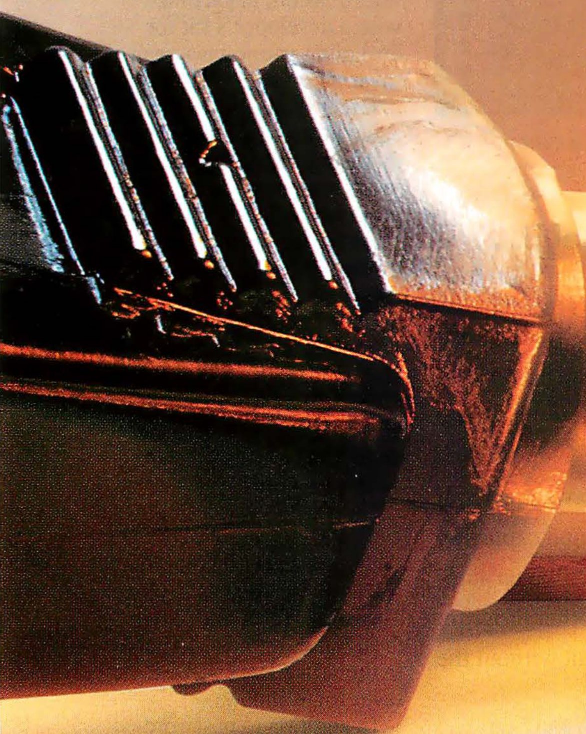
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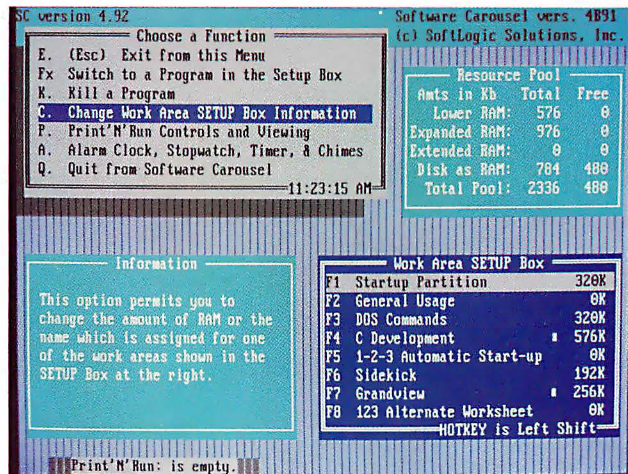
Two Neural Net Programs for Business

BrainMaker Professional 2.0, the program for the IBM PC that can forecast stock prices, medical diagnoses, and other events, can now read data from other applications in dBASE, Lotus 1-2-3, ASCII, and Excel formats. Once you've imported the data, you can use the NetMaker Professional portion of BrainMaker to perform arithmetic operations on data and build network description and training files automatically, according to California Scientific Software.

New features of version 2.0 include network optimization, for determining the best number of hidden neurons, and pruning, for removing unnecessary synapses and improving the network's ability to generalize. The company also expanded the program's network tools by adding a new program to rank competing entities in predicted finish order (e.g., for sporting events).

Hypersonic training, a method for training networks using linear algebra and matrix manipulation and the proprietary Hypersonic algorithm, is now included with the program.
Price: $795.
Contact: California Scientific Software, 10141 Evening Star Dr., Suite 6, Grass Valley, CA 95945, (800) 284-8112 or (916) 477-7481; fax (916) 477-8656.
Circle 1279 on Inquiry Card.

An add-in program called Neuralyst for Microsoft Excel lets you perform pattern matching, adaptive processing, and fuzzy analysis without data translation or reformatting. According to Epic Systems, you can use Neuralyst for stock and commodities price prediction, insurance risk rating, signal processing, robotic control systems, and other areas from data stored in Excel worksheets. The program works with any version of Excel that runs under Windows 3.0.
Price: $145.
Contact: Epic Systems Group, 3814 East Colorado Blvd., Suite 101, Pasadena, CA 91107, (818) 564-0383; fax (818) 564-0322.
Circle 1280 on Inquiry Card.



Software Carousel 5.0 provides task switching and a cut-and-paste facility on any DOS-based PC.

Snip and Snap with Carousel 5.0

The new version of the IBM PC task-switching system Software Carousel includes reduced RAM requirements on 286- and 386-based machines and a Snip 'n' Snap cut-and-paste facility.

Version 5.0 lets you transfer information between files of the same or different applications by marking and capturing data directly from an application screen. Snip 'n' Snap automatically reformats and transfers data into another program as if you'd entered the data from a keyboard but without the risk of transpositions or other typos.

On 386-based systems, the program now requires as little as 4K bytes of RAM. A C interface lets you add Carousel's task-switching functions to other applications.
Price: $89.95.
Contact: SoftLogic Solutions, Inc., One Perimeter Rd., Manchester, NH 03103, (800) 272-9900 or (603) 627-9900; fax (603) 627-9610.
Circle 1283 on Inquiry Card.

Two Screen Savers for Windows

Icom Simulations' new screen saver for Windows 3.0 offers more than 30 animated displays, including a Message display that shows your custom scrolling message. The program, called Intermission, also comes with a developer's kit for designing your own screen-saver modules.

Other displays include an aquarium and a Slide Show that lets you put together your own presentation. The program includes a password protection system.
Price: $49.95.
Contact: Icom Simulations, Inc., 648 South Wheeling Rd., Wheeling, IL 60090, (800) 877-4266 or (708) 520-4440; fax (708) 459-3418.
Circle 1281 on Inquiry Card.

More than 20 color displays, such as Flying Toasters, Warp, and Down-the-Drain, are now available in the After Dark screen saver for Windows.

In addition to password security and the color display modules, the program's Logo module lets you scan in a logo, which drifts around the screen when the screen saver engages. The program also uses SystemIQ. When system activity exceeds a set limit, SystemIQ causes After Dark to throttle back so that it doesn't compete with other tasks, such as a file transfer, backup, or other processing.
Price: $49.95.
Contact: Berkeley Systems, Inc., 1700 Shattuck Ave., Berkeley, CA 94709, (415) 540-5535.
Circle 1282 on Inquiry Card.

Anti-Obsolescent. Forval Super High-Speed V.32bis/V.42bis Modems.

Enhancements for your modem are just a phone call away. Simply dial FORVAL's headquarters and FORVAL-Link™ assures speed or feature upgrades automatically. Your modem is protected against obsolescence.

With FORVAL Turbo Interface,™ data integrity is ensured even at speeds greater than 19.2Kbps.

Modem can be used horizontally–or vertically when you need to save desktop space.



Forval's super high-speed dial-up modems are currently the fastest full duplex modems on the market–up to six times faster than ordinary V.32 modems. And they are compatible with all lower speed modems.

Completely compatible with CCITT dial-up standards.

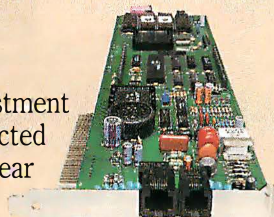
Controls and displays ensure complete visibility and management over modem operation.

Now you can get all this for the same amount you would spend on an ordinary V.32 modem.

Introducing the SA14400 from Forval. The first super high-speed modem designed to discourage obsolescence.

And don't worry about compatibility. Forval modems are compatible with all dial-up modem standards. So you can talk to anyone. Anywhere. No matter what the line conditions.

Your investment is also protected with a five-year warranty. And free high-speed communications software is included in the package.



Also available in board model for internal PC use.

So if you want a super high-speed modem that has it all, think of us.

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To learn more about our complete line of modems, call us today at **1-800-FORVAL-1.**

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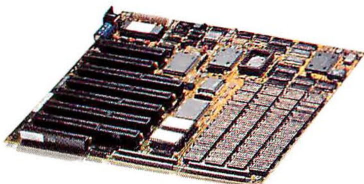
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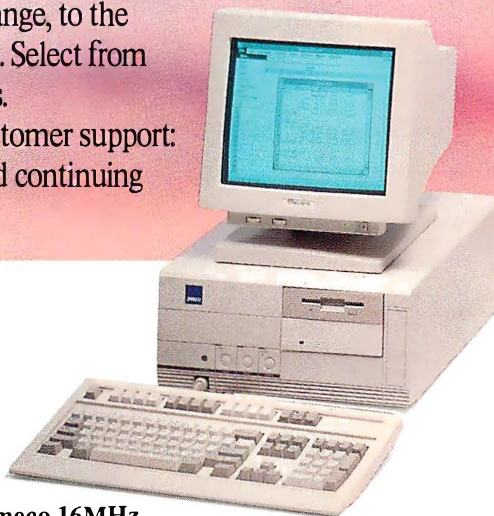
Over the past 16 years, Jameco has mastered the distribution of quality electronic components, computer products, and test and measurement equipment. That's why our market intelligence group tracks the very latest technology. Our purchasing groups buy globally for the best quality and value, thoroughly prequalifying each vendor and product against our high standards. And our in-house quality assurance group constantly tests products received into stock.

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- 2MB RAM (expandable to 8MB)
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- DR DOS 5.0 and QAPlus diagnostic software

$1199.95/JE3816
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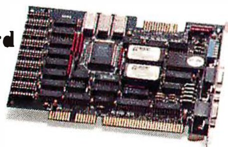


Jameco 33MHz 32KB Cache 80386 Computer Kit
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- 6 half-height drive bays
- 101-key keyboard • Multi I/O Card
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Microspeed PC Trackball



Jameco VGA Card



Conner IDE Hard Drive

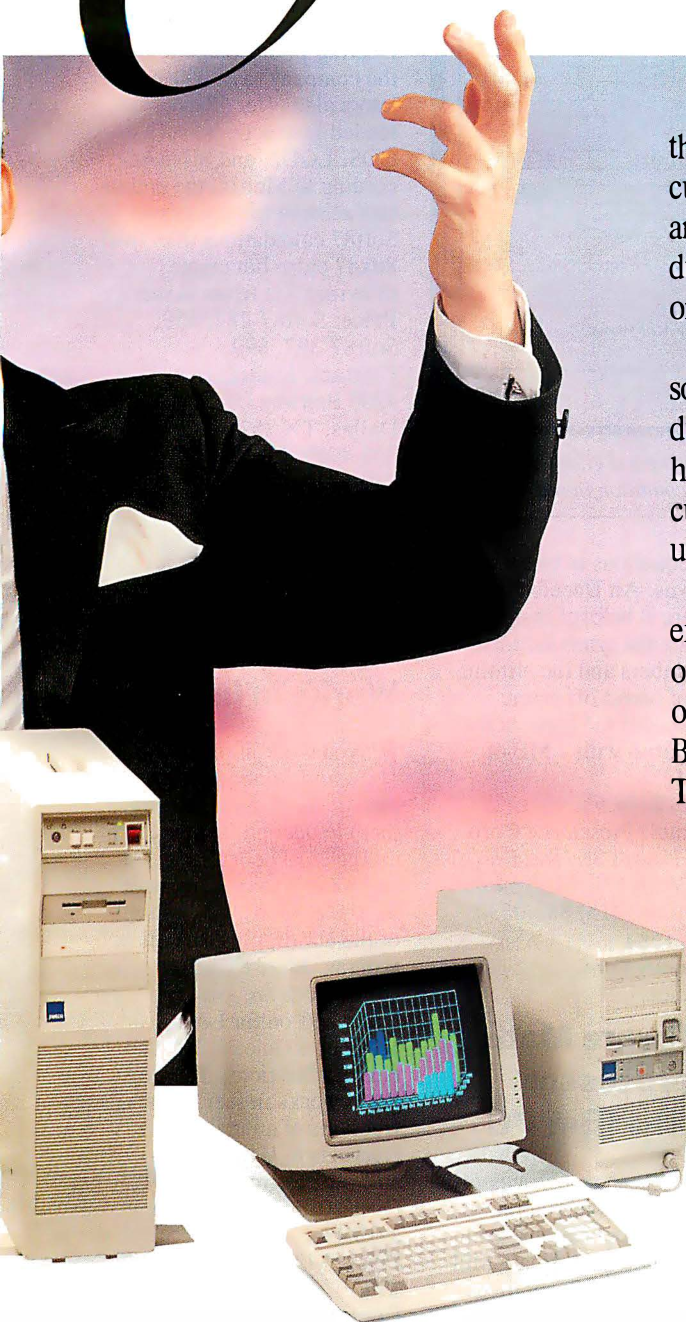




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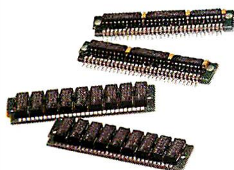
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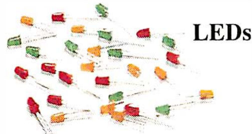
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FAX: (415) 592-2503

Jameco 20MHz 32KB Cache 80386SX Computer Kit
- AMI Motherboard with 32KB cache, 4MB RAM (expandable to 16MB)
- 200 Watt power supply
- 101-key keyboard • Multi I/O Card
- Toshiba 1.44MB, 3.5" floppy drive
- DR DOS 5.0 and QAPlus diagnostic software

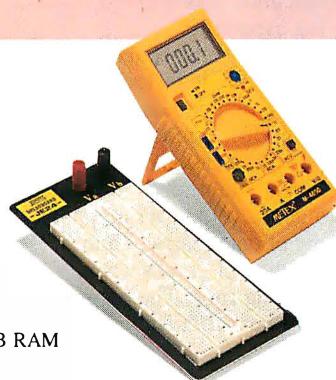
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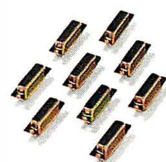
Memory Modules



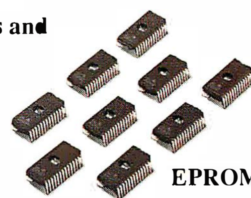
LEDs



Jameco Breadboards and Metex Multimeters



DB25 Connectors



EPROMs



Axial and Radial Capacitors

Circle 152 on Inquiry Card.

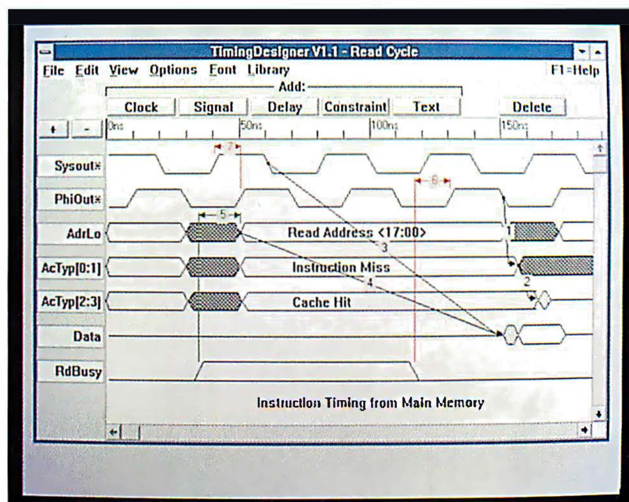
Automate Circuit Timing Diagrams

A new Windows 3.0 program makes it easier for electronics engineers to specify, modify, and check timing requirements for digital circuits. TimingDesigner is a front-end design tool that can ease the process of creating timing diagrams, which describe the detailed sequence of and relationship between events that must occur for a logic design to work properly. The program lets you enter and modify by pointing and clicking on all elements of a timing diagram, including waveforms, clocks, gate and path delays, setup and hold times, timing parameter tables, and text annotations.

As you modify the diagram, the program maintains the timing relationships specified between waveform edges. As you move the location of an edge that is dependent on other edges, all the related edges in the diagram move automatically to maintain the specified minimum and maximum delays.

The program automatically performs timing analysis calculations that are updated during diagram modification. TimingDesigner displays the earliest and latest time that every edge can occur, computes the available margins for all timing limits, and highlights in red any timing conditions that have been violated. The program lets you keep a set of files that other engineers can access.

The program can display and edit any digital data generated by other tools, logic analyzers, simulators, and testers. It also supports delay back annotation from gate array routers.
Price: $1495.



When you violate a timing limit in designing a digital circuit, TimingDesigner highlights your invalid condition in red.

Contact: Chronology Corp., 2849 152nd Ave. NE, Redmond, WA 98052, (206) 869-4227; fax (206) 869-4229.
Circle 1077 on Inquiry Card.

Faster, Better Theorist

Theorist, the symbolic algebra system for the Macintosh, is faster and more powerful in version 1.1, which has enhanced calculus, algebra, and graphing capabilities.

Improvements to the program include factoring of large polynomials (of up to order 30), symbolic integration of all rational fractions, better noncommutative algebra, and faster graphing of data matrices and drawing of graphs when opening files. The program's nonlinear root finder solves two equations in two unknowns. An Uncalculate feature is helpful in determining the symbolic form of numbers and the elimination of round-off error.

Theorist 1.1 runs on the Macintosh with 1 MB of RAM.
Price: $399.95.
Contact: Prescience Corp., 939 Howard St., San Francisco, CA 94103, (415) 543-2252; fax (415) 882-0530.
Circle 1284 on Inquiry Card.

Software Math Coprocessor for the IBM PC

If you need a coprocessor for your computation-intensive applications, you may want to investigate Multix's line of math coprocessor emulators.

Soft87-287, designed for 286-based machines, and Soft87-387, which supports 286, 386, and i486 processors, emulate floating-point calculations and are IEEE floating-point compatible, the company says. The emulators also offer 57 extended instructions, such as COS, LOG2, and SIN. According to Multix, the emulators achieve more accurate Soft87 calculations than Intel 80x87 chips but create drawings 3½ times slower.
Price: Soft87-287, $59; Soft87-387, $99.
Contact: Multix, Inc., 4203 Beltway Dr., Suite 7, Dallas, TX 75244, (214) 239-4989; fax (214) 239-6826.
Circle 1285 on Inquiry Card.

Pop-up Calculator Works in Inches

If you work in feet, inches, and fractions of an inch and are tired of converting them to decimal format, Pop an Inch can help. The memory-resident calculator for the IBM PC works in all of the above, plus degrees or radians. More than 300 conversions are available.

An add-on for Lotus 1-2-3 up to release 2.2 also handles fractions. The program works in feet, inches, fractions of an inch, stock fractions to $^1/_{32}$, or bonds and futures fractions to $^1/_{64}$. Over 20 @ functions are available.
Price: $49; 1-2-3 add-on, $99.
Contact: Workhorses, Inc., 805-B 14th St., Golden, CO 80401, (800) 777-2477 or (303) 279-8557; fax (303) 278-4029.
Circle 1286 on Inquiry Card.

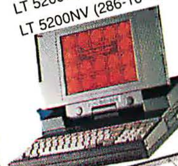
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Circle 582 on Inquiry Card (RESELLERS: 583).

NEWS

PROGRAMMING TOOLS

Windows GUIs for Mainframe Applications

With the release of the Easel/Win tool for adding graphical user interfaces to client-server or mainframe cooperative-processing applications, Easel Corp. now provides interface design tools for Windows, DOS, and OS/2.

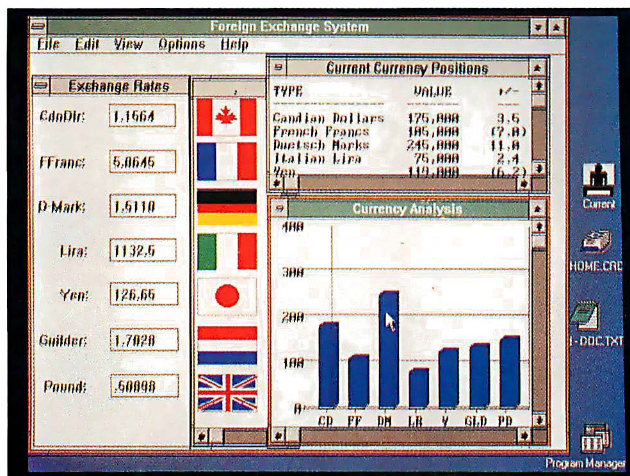
Easel/Win simplifies the creation of these types of applications by providing a high-level interface to a variety of IBM and DEC communications protocols, the company says. Easel/Win provides direct support for the Microsoft Structured Query Language Server database for creating client-server applications. You can manipulate SQL Server by issuing dynamic SQL statements from within the Easel application.

The tool provides a simplified interface to the Dynamic Data Exchange protocol, and you can incorporate custom functions written in C through dynamic link libraries or interprocess communications. The Windows Clipboard is also accessible for letting end users control the flow of data among programs.

Price: $7500.

Contact: Easel Corp., 600 West Cummings Park, Woburn, MA 01801, (617) 938-8440; fax (617) 932-0349.

Circle 1174 on Inquiry Card.



Easel/Win's communications capabilities let you build integrated graphical interfaces for cooperative processing and client-server applications.

Version Control for Brief

Sourcerer's Apprentice, Solution Systems' version-control program for programmers, works seamlessly with the Brief programmer's editor for DOS and OS/2. The program lets you maintain an accurate record of each version of files as you revise your work. Sourcerer's Apprentice saves only the differences from one version to the next, thus saving space.

For use in a multiuser environment, Sourcerer's Apprentice's locking feature prevents someone else from revising a module once you've checked it out. The professional version also supports branching, helpful for developing a program for multiple platforms. For creating alternate lines of development on individual modules, branching is helpful when a module requires operating-system-specific code to be ported to another operating platform.

Price: $199; professional version, $499; for Brief owners, $149 and $349, respectively; five-user pack, $1749.

Contact: Solution Systems, 541 Main St., Suite 410, South Weymouth, MA 02190, (800) 821-2492 or (617) 337-6963; fax (617) 337-7719.

Circle 1175 on Inquiry Card.

Reverse Engineering for COBOL

For analysts who reverse-engineer or enhance existing applications, Source/RE provides graphical and textual displays of the design logic structure of COBOL programs.

Source/RE automates the application of path-analysis techniques. In addition to creating analyses that represent flow-of-control through the analyzed system, Source/RE can compile statistics on language syntax, program size and complexity, and database access.

Source/RE requires 640K bytes of RAM on DOS-based systems. Future plans call for extended memory support under DOS, Windows, and OS/2 versions.

Price: $3800; LAN systems, $9600 (minimum of six copies).

Contact: Transform Logic Corp., 8502 East Via de Ventura, Scottsdale, AZ 85258, (800) 825-6442 or (602) 948-2600; fax (602) 951-8179.

Circle 1176 on Inquiry Card.

Program in English with The Brain

A new program called The Brain lets you develop programs using plain English rather than code, according to Ingenio.

The Brain, which runs on DOS systems, offers development tools for creating low-, medium-, and high-level objects while maintaining a dictionary of objects. Interface routines for BASIC, COBOL, Pascal, and C are available.

Tedious documentation-writing tasks are also a thing of the past with The Brain, Ingenio claims. Its documentation system automatically prints definitions and listings.

Price: $795.

Contact: Ingenio, Inc., 6025 The Corners Pkwy., Suite 205, Norcross, GA 30092, (404) 441-1547; fax (404) 441-1703.

Circle 1177 on Inquiry Card.

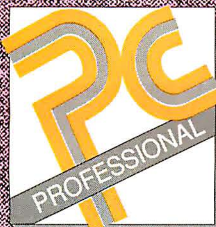
Protected-Mode 386 Graphics Library

A 32-bit, 386 protected-mode extended graphics library supports graphics directly to hardware for IBM standard and other modes. Libhpgl.lib supports mixed vector plotting and raster imaging, partial screen windowing, user unit scaling, and rotatable and scalable labels for resolutions of up to 1024 by 768 pixels with 8-, 16-, or 32-bit graphics cards.

Price: $200.

Contact: Gary R. Olhoeft, P.O. Box 10870 Edgemont, Golden, CO 80401, (303) 279-6345.

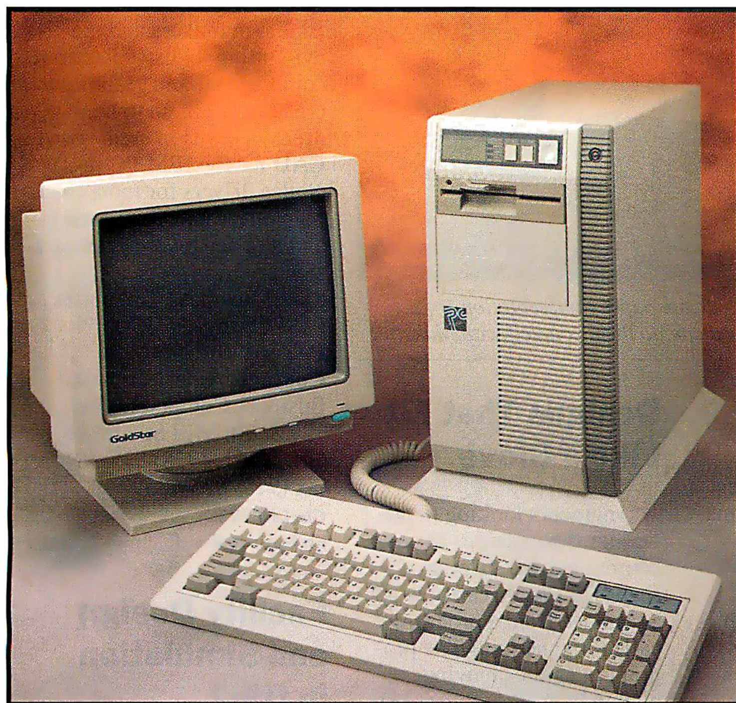
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- Microsoft DOS 4.01

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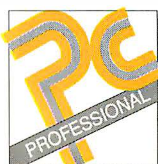
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Circle 573 on Inquiry Card (RESELLERS: 574).

An Easy Way to Make Physical Models

Two programs from ACAD-Group are designed to ease the process of making a physical model to show a client during the first design phase.

A CAD-Makette helps you turn a three-dimensional AutoCAD model into a 3-D paper model that you can show to the client. A CAD-Group says the program is an inexpensive alternative to hiring an artist to make a physical model.

The program takes the AutoCAD model and "unfolds" it, making a special drawing file that, when plotted, includes foldlines and gumslips for making a paper model. In addition to providing the floors, ceilings, and walls for square buildings, you can also generate wraparound facade drawings for windows and doors, text, and patterns. Segments can be straight lines or arcs.

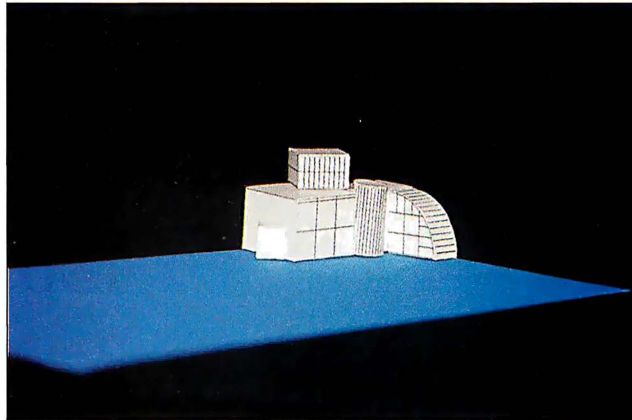
A CAD-Site works within AutoCAD release 10 for DOS to help you quickly generate 3-D prototype building designs. To help you create a 3-D house, the program provides an icon menu, from which you select representations like various housing types. You can accept defaults or provide new dimensions and edit information like roof slope and ridge length.

The menu provides results of measuring built-up areas, volumes, roof areas, and space diagrams, which you can use to maintain cost calculations.

Price: A CAD-Site, $895; A CAD-Makette, $275.

Contact: A CAD-Group, Inc., 233 Peachtree St. NE, Suite 404, Atlanta, GA 30303, (404) 523-8544; fax (404) 522-7116.

Circle 1179 on Inquiry Card.



Instead of hiring an artist to create paper representations of a three-dimensional model, you can do them yourself with Makette.

Designs That Fit Like a Glove

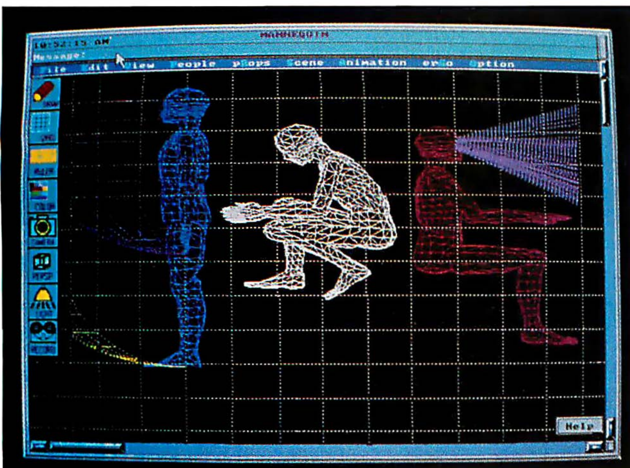
Engineers looking to tailor their designs to accommodate the diverse shapes of people can now get assistance from a program called Mannequin. The program integrates moving human likenesses into CAD and graphical designs created in programs such as AutoCAD, Harvard Graphics, and PageMaker.

The program can animate humans as they would see, walk, bend, and grasp objects in relation to the design. People come in all shapes and sizes, so Mannequin can draw human figures from 10 populations, including North and South America, Europe, and the Far East. It draws likenesses of men, women, and children in five different body sizes, from extra small to extra large.

Price: Before June 3, $499; after, $699.

Contact: HumanCAD, 1800 Walt Whitman Rd., Melville, NY 11747, (516) 752-3568; fax (516) 752-3507.

Circle 1180 on Inquiry Card.



Mannequin offers help for ergonomically minded designers who want to see how humans fit into their designs.

CAD for Sign Makers, Vinyl Cutters

A new CAD program for sign makers and the vinyl-cutting industry lets you combine text and graphics to create signs of up to hundreds of yards in area. Vinyl-CAD for the IBM PC includes drivers for more than 80 plotters and vinyl cutters and a raster-to-vector conversion program, American Small Business Computers (ASBC) says.

Price: $799.

Contact: American Small Business Computers, Inc., 327 South Mill St., Pryor, OK 74361, (918) 825-4844; fax (918) 825-6359.

Circle 1181 on Inquiry Card.

Facility Design and Simulation in OS/2

For manufacturers designing new facilities, assembly lines, and systems, Slamsystem lets you simulate a project from beginning to end using multiple scenarios.

The program supports all phases of a simulation project, from graphical model building to comparison of data, complete with multiple scenarios and lifelike animations and displays, Pritsker reports.

Slamsystem, when combined with the included Slam II simulation language, supports distributed simulation under OS/2's Presentation Manager.

Price: $18,000.

Contact: Pritsker Corp., 8910 Purdue Rd., Suite 500, Indianapolis, IN 46268, (317) 879-1011; fax (317) 879-0500.

Circle 1182 on Inquiry Card.

Automate Employee Evaluations

A new program for DOS- and OS/2-based systems provides employers with a customizable tool for automating employee evaluations and salary distribution. Hi Tech Enterprises (HTE) says you can use the Employee Evaluator & Salary Manager to perform accurate and objective evaluations that you can use as court-admissible evidence.

You can buy the program with a set of modifiable questions (e.g., "How many times on average was the employee late per week?") in several categories for evaluating employees. You can also generate your own questions. Once you've decided on the categories and questions for assessing employees, you can determine the importance of each by using weighting techniques.

The program can generate written reports, graphs, and goal sheets.

On DOS-based systems, the program requires 640K bytes of RAM. HTE says the program takes advantage of multitasking under OS/2 but not Presentation Manager.

Price: Without base questions, $290; with base questions, $340.

Contact: Hi Tech Enterprises, 33 Soledad Dr., Monterey, CA 93940, (408) 373-5117; fax (408) 649-2376.

Circle 1183 on Inquiry Card.



After a manager has rated employees, the Employee Evaluator & Salary Manager provides a score that can be used to determine pay raises.

Write Resumés That Get Noticed

A program called ResumeMaker helps you write resumés by teaching you how to plan, organize, and manage a job-seeking campaign while providing expert advice for successful interviewing.

An on-line glossary of action words that appeal to employers and express your accomplishments is included with the program. The Guided Letter System helps you compose professional letters.

You can use the target company database to list all your prospective employers, addresses, contact names, and sources; an activities log organizes and sorts a list of all potential sources for the next career move, including placement agencies and professional societies.

ResumeMaker runs on DOS-based systems with 512K bytes of RAM.

Price: $49.95.

Contact: Individual Software, Inc., 125 Shoreway Rd., Suite 3000, San Carlos, CA 94070, (800) 331-3313 or (415) 595-8855.

Circle 1185 on Inquiry Card.

Create an Employee Handbook

Navigating through the maze of labor laws and federal agency mandates can often stall the process of creating an employee handbook. But Personnel Policy Expert can help solve that problem by providing information on over 60 subjects (e.g., safety, sick leave, vacation benefits, and workers' compensation). Version 2.3 adds a Benefits Continuation-Consolidated Omnibus Budget Reconciliation Act policy.

As you select subjects, you learn what you should be communicating to your employees, KnowledgePoint says.

The program requires 512K bytes of RAM.

Price: $395; one-year subscription to policy maintenance program, $95.

Contact: KnowledgePoint, 1311 Clegg St., Petaluma, CA 94954, (800) 727-1133 or (707) 762-0333; fax (707) 762-0802.

Circle 1186 on Inquiry Card.

On-Screen Testing for AutoCAD

CADStudio's AutoCAD Evaluator version 10 is an on-screen test designed to help employers quickly and accurately assess the AutoCAD skills of their applicants. The Evaluator asks 100 multiple-choice questions covering basic to advanced knowledge on numerous topics.

CADStudio offers other evaluation programs for DOS, dBASE III, AutoLisp, Windows, and Lotus 1-2-3.

Price: $149.

Contact: CADStudio, 3636 Executive Center Dr., Austin, TX 78731, (800) 369-9099 or (512) 346-8399.

Circle 1184 on Inquiry Card.

Job Applicant Tracking on the Mac and PC

The new version of AbraTrak for DOS-based systems includes a built-in letter generator that permits mass updates to the letters file. With mass updates, you can send letters to all applicants for a specific position notifying them that the position is filled without sending the same letter to the newly hired person.

On the Mac platform, the company now has a multiuser version for AppleShare-compatible networks.

Price: $995 for stand-alone version; network version, $1990.

Contact: Abra Cadabra Software, Inc., 5510 Ninth St. N, St. Petersburg, FL 33703, (813) 525-4400; fax (813) 525-3254.

Circle 1187 on Inquiry Card.

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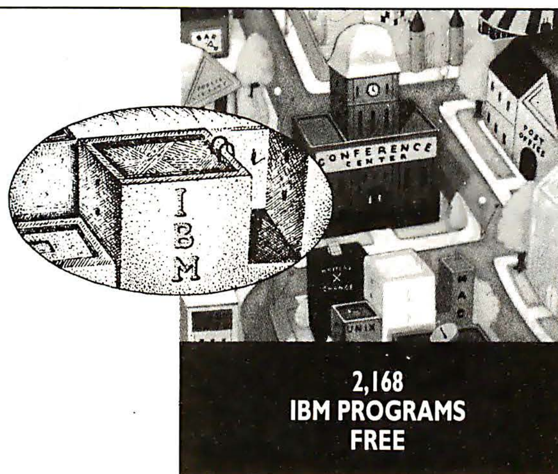
For Technical Support Call: 1-800-950-0182





6640 Shady Oak Road; Eden Prairie, MN 55344; FAX: 612-943-3854; TEL: 612-943-8618

Circle 593 on Inquiry Card (RESELLERS: 594).



■ In the BIX community we take care of people who use IBM PCs or their compatibles. For example, our IBM Exchange offers a growing list of programs which you can download for free. These 2,168 programs are the cream of the crop. All of them are tested in advance by BIX moderators so you know you're getting top-quality, virus-free programs. Here are some of the most popular ones:

BIX FILE NAME	BIX CONFERENCE	DESCRIPTION
stars.zip	microsoft	Utility that turns your Windows desktop into a view of deep space. Choose impulse or warp speed and launch several Windows utilities from a floating pop-up menu.
e.arc	ibm.utils	Public-domain text editor, with source code.
secrets2.arc	ibm.dos	Condensed and edited messages from the ibm.dos/secrets topic. Tricks and undocumented internals of MS/DOS.
tetris2.zip	microsoft	KLOTZ, a Tetris• clone for Microsoft Windows 3.
2zip25.zip	ibm.utils	Converts a variety of archive formats (including ARC, PAK, ZOO, LZH) to PKWare's ZIP format.
w3icons.zip	microsoft	40 new icons for the Windows 3 Program Manager.
firework.zip	microsoft	Fireworks display in a window, for Windows 3.
monitor.arc	ibm.os2	Continuous display of CPU load for OS/2 Presentation Manager.
abort.exe	ibm.utils	TSR that aborts any program when you press Alt-C.
dis386.zip	ibm.utils	Full-screen interactive machine language disassembler for 8086, 80286, 80386, NEC V20.

Besides great free programs, the IBM Exchange offers dozens of informative and provocative conferences on OS/2, PC/DOS and MS/DOS operating systems, alternative 386 operating systems, utility software, communications programs, LANs and more. There's even a "Repairshop" conference, and maybe as a last resort, an IBM clearing house. Beyond our IBM Exchange, we provide industry news and product information that's essential to your performance as a microcomputer pro. All of these privileges are yours with a subscription to BIX. To find out more, call our special Customer Service number: 1-800-227-2983 (in NH call 603-924-7681).

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AS 1401 (Amber) $129.00
WS 1401 (White) $129.00

MEMORY BOARDS



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R-Meg w/0K for AT $150.00

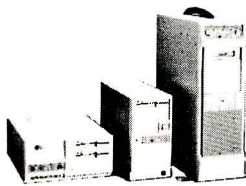
EA.4 up to 8MB using 1MB SIMM extended and expanded memory. Hardware & software support of LIM EMS 4.0
EA.4 w/0K for AT $167.00

A.4 up to 2MB using 256 x 1 DIPS
Extended and expanded memory, supports LIM EMS 4.0
A.4 w/0K for AT $83.00

X.4 XT memory board, up to 2MB using 256K DIPS for expanded memory, supports LIM ESM 4.0
X.4 w/0K for XT $72.00

PII-129 XT up to 640K using 64K and 256K DIPS for expanded memory
PII-129 w/0K for XT $22.00

COMPUTER CASES



CTI-101 CTI-601T CTI-747T

CTI-101 Compact Case
- Slide-in case for bay AT, bit AT or XT compatible
- For three 5.25" & one 3.5" FDD
- 3 LED indicators & keylock
- Patent reset switch to prevent data loss
- 200 watt power supply
- 1.2 mm sheet metal
- Dimensions: 14-⅛" x 16-5¼" x 6-⅝"

CTI-101 $114.00

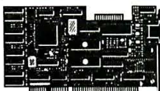
CTI-601T Mini Tower Case
- Mini tower case for baby AT or XT compatible
- For two 3.5", two 5.25" FDD & one 3.5" HDD
- 3 LED indicators & keylock
- Patent reset switch to prevent data loss
- 200 watt power supply
- 1.2mm sheet metal
- Dimensions: 7" x 16" x 13¼"

CTI-601T $114.00

CTI-747T Tower Case
- Big tower case for baby AT, bit AT or XT compatible
- For four 5.25" FDD (one of the four can be for 3.5" FDD) and two full height HDD
- With keylock, patent Turbo & Reset switch
- 230 watt power supply
- 1.2 mm sheet metal
- Dimensions: 8" x 18" x 25"

CTI-747T $207.00

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TVGA 16-BIT • W/512K • 1024 x 768 • 16 Colors	$120.00
TVGA 16-BIT • W/1MB • 1024 x 768 • 256 Colors	$146.00
PVGA 256K Exp. to 512K • 1024 x 768 • 16 colors	
W/256K • 800 x 600 • 16 Colors	$97.00
W/512K • 1024 x 768 • 16 Colors	$122.00
PGVA 256K Exp. to 1MB • 1024 x 768 • 256 Colors	
W/256K • 800 x 600 • 16 Colors	$155.00
W/512K • 1024 x 768 • 16 Colors	$170.00
W/1MB • 1024 x 768 • 256 Colors	$196.00

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XT/AT Hi Den Floppy (2 drives)	PTI-151	$28.00
XT MFM Dual HD	WDGEN2+	$49.95
XT RLL Dual HD	WD1004-27X	$49.95
AT RLL Dual HD/FD 1:1	WD1006V-SR2	$129.95
AT RLL Dual HD/FD 1:1 32K Cache	PD1452	$102.00
AT RLL Dual HD 1:1 32K Cache	PD1451	$89.00
AT MFM Dual HD/FD 1:1 32K Cache	PD1462	$94.00
AT MFM Dual HD 1:1 32K Cache	PD1461	$83.00
AT MFM Dual HD/FD 1:1	HC-315	$84.00
AT IDE Dual HD/FD 1:1 1 par. 1 ser. game	PTI-217	$47.00
AT IDE Dual HD/FD 1:1	PTI-215	$27.00
AT IDE Dual HD/FD 1:1 32K Cache	PD1442	$35.00
AT IDE Dual HD/FD 1:1 2 ser. 1 par. 32K Cache	PD1443	$53.00
AT ESDI Dual HD/FD 1:1 OEM PAKNo Manual	WD1007A	$99.00

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Mono Text Card XT	MTO	$6.00
No Slot Clock on Chip XT	NSC	$20.00
4 Port RS232 Card XT/AT	(MP-001)	$87.00
2 Ser. 1 Par. Game XT/AT	IX-404	$26.00
2 Ser. 1 Par. Game, Floppy XT	IX-201	$34.00
101 Enhanced XT/AT Keyboard	KB400	$35.00

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AT Hard Drive Mounting Rails	$1.95



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GeniusDynaMouse $34.50



Includes:
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- Genius Mouse Pocket & Pad
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SRM-2496E	External 9600 BPS Send/Receive Fax Board and 2400 BPS Modem W/Software. Free Prodigy Start Up Kit & 1 Month Service	$318.00
SRX-9600	Internal 9600 BPS Send/Receive Fax Board, Receive Fax While Performing Other Tasks; Software. Included Free Prodigy Start Up Kit & 1 Month Service	$198.00
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Optical Document Storage

The new version of the PaperTamer Professional document storage and retrieval program supports optical character recognition using the Toshiba Express Reader OCR card, fax send and receive, and the automatic detection of image file formats when importing image files.

Version 2.0 offers support for full-page monitors and fuzzy set matching on search criteria. It also supports optical jukeboxes, removable optical drives, and multiple storage devices. You can organize scanned items in virtual folders, drawers, and file cabinets and retrieve documents through a natural-language interface.

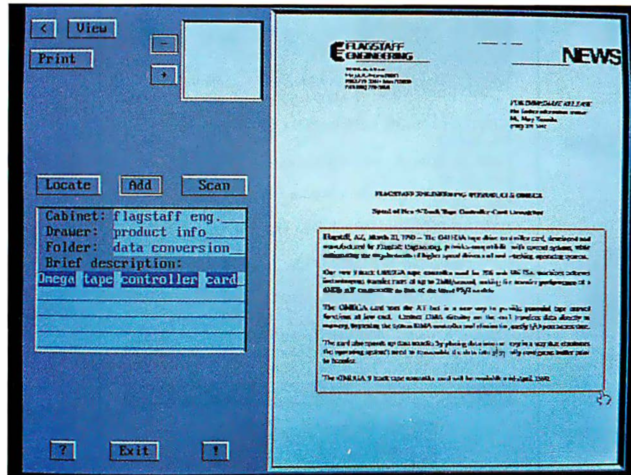
The program can input documents from most popular desktop image scanners and from existing FAX, G3F and G4F, PCX, SPOT, or TIFF image files.

For the home office or small business, PaperTamer Personal Edition 1.2 offers a simplified interface for storing documents.

Price: PaperTamer Professional, $695; PaperTamer Personal Edition, $195; PaperTamer Network, $2995.

Contact: Flagstaff Engineering, 1120 Kaibab Lane, Flagstaff, AZ 86001 (800) 346-3627 or (602) 779-3341; fax (602) 779-5998.

Circle 1188 on Inquiry Card.



When scanning a document or image, PaperTamer lets you identify what you're storing with a description of up to 128 characters and 32 keywords.

Multimedia LAN Database

The SantaFe Media Manager, a multimedia database that lets you store and recall photo-realistic still images, video, audio, and text, is now available in a LAN version.

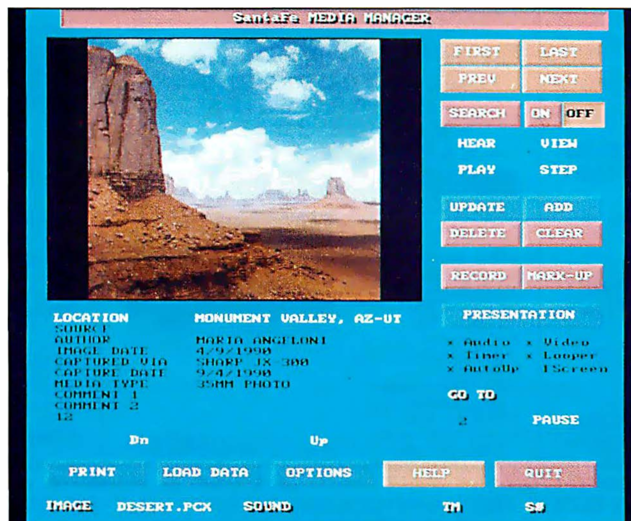
The program supports PCX, GIF, or FLI (the standard file for Autodesk Animator) graphics files.

The minimum system configuration is a 12-MHz 286 AT with 640K bytes of memory and 400K bytes of available expanded memory, an SVGA monitor and video card with 512K bytes of RAM, and a hard disk drive. Two Targa versions require 640K bytes of available expanded memory (for the Targa 16) or 960K bytes of expanded memory (for the Targa 24). The LAN version supports NetWare, Vines, and other LANs.

Price: Stand-alone version, $595; LAN version: $895 for a full workstation/server system; $150 for each LAN node.

Contact: HSC Software, 1661 Lincoln Blvd., Suite 101, Santa Monica, CA 90404, (213) 392-8441; fax (213) 392-6015.

Circle 1189 on Inquiry Card.



The SantaFe Media Manager offers a sound, image, and text database running over the Paradox database engine.

Law Office Management on the Mac

The MacLaw 2.0 office productivity program for legal practices lets you track scheduling, billing, clients, and matters on the Mac. The program lets you search and sort information by subject matter, including clients, matters, attorneys, billing, phone calls, calendar, mail, and multiparty and class actions.

The program includes a relational database, logs phone calls in real time, and bills automatically.

MacLaw runs on the Mac Classic or higher with 4 megabytes of RAM.

Price: $5000 and up.

Contact: Manhattan Software, Inc., 865 Manhattan Beach Blvd., Suite 204, Manhattan Beach, CA 90266, (213) 545-6462.

Circle 1190 on Inquiry Card.

Document/ Image Management

A new optical-based information management program for Windows lets you drive retrieval requests through your existing applications using terminal emulation or Dynamic Data Exchange. Target supports source document scanning, documents downloaded from mainframes, work flow/ document routing, and fax input and output. It supports 3270, 5250, VT-100, VT-220, HP, and asynchronous terminal emulation.

Price: $2500 to $29,000.

Contact: AIM Systems, Inc., 1130-D Burnett Ave., Concord, CA 94520, (415) 682-7922; fax (415) 682-7994.

Circle 1191 on Inquiry Card.

Microsoft: The C> Prompt Is Dead

After a 45-minute wait as he attempted to revive a failed 386 portable, Craig Herb of Microsoft explained how "DOS allowed a standard to be born," and how Windows builds on the success of DOS.

Speaking at a general meeting of the Triangle Computing Society, Herb said Windows appeals to five types of users: (1) novice users who can benefit enormously from the simple graphical user interface; (2) those who need Windows' multitasking capabilities and access to extended memory; (3) corporate America, which benefits from the consistent look and feel of applications; (4) those who have decided that "computers aren't fun anymore"; and (5) people who seek value in the utilities, games, and File Manager.

Herb declared that due to the File Manager, which doesn't require you to learn syntax, "the C prompt is dead." The File Manager, he said, "lets you drag icons with a mouse to copy files and start applications." However, he didn't mention the fact that several third-party developers have announced or shipped utilities that replace the File Manager, which many find less intuitive and harder to use than the Mac interface.

Herb said 900 applications currently support the Windows application programming interface, and 1000 more will become available in the next year. He also said that 1 MB of RAM and a 286 is the minimum hardware configuration to use with Windows. However, a 386 is necessary to take full advantage of Windows, he said.

An IBM representative in the audience, who was no doubt watching the presentation with interest, mentioned that OS/2 1.3 was being announced that day and noted that its minimum memory requirement had dropped from 4 MB to 2 MB of RAM.

—Robert Bean

The Classic as a Diskless Workstation?

During a regular Thursday meeting of BMUG, the Mac users group in Berkeley, California, members speculated about what you might do with the diskless booting capability of the newer Macs, including the Mac IIfx.

According to BMUG members, using System 6.0.3 along with Finder 6.1x, you can boot the Mac Classic directly from the ROM disk without either a floppy disk or a hard disk. To accomplish this, press the Command, Option, *X*, and *O* keys simultaneously. One BMUG member said Apple has demonstrated the Classic as a diskless workstation.

—Kandy Arnold

Next Focuses on Connections, Applications

Next is working on expanding the networking and communications capabilities of its computers, according to comments made by company chairman Steve Jobs. By this summer, Next computers will support Novell NetWare clients and links to AppleTalk via EtherTalk. The NetWare client support will let Next users access Novell files easily, he said. The AppleTalk connection will eliminate having to use a $4000 Cayman Gatorbox to hook Next machines to Macs, Jobs said.

The new interface for the Simple Message Transfer Protocol that Next uses makes it "something that's usable by mere mortals," Jobs said. At a meeting of the Boston Computer Society, Jobs showed a sample Next E-mail document and how you could put elements such as sound, graphics, text, and data in one message just by cutting and pasting. To help you navigate through complex network paths, Jobs showed how the Next software provides a history of the message with an icon history. By this summer, the company hopes to add the capability of storing live, full-motion video in that E-mail message. This will be done using Joint Photographic Experts Group compression.

Networking with a Unix-based Sun workstation is currently 10 times better than on a PC, "but you have to be a rocket scientist to do it," Jobs said. What Next wants to do is use E-mail's store-and-forward mechanisms ("it's the way to go") with the Next machine's ability to easily combine different kinds of data from various applications. He also mentioned something called Godzilla, which he described as a kind of closely coupled parallel network using E-mail.

Jobs trumpeted the releases of Lotus Improv, WordPerfect, Adobe Illustrator, FrameMaker, and QuarkXpress for the Next. "We spent 1990 getting our product line together and getting applications," he said. "Applications are coming out like mad. Company after company, it's really happening out there."

—Dave Andrews

Two Computer Shows

The Second Annual Central Kentucky Computer Society Computer Show on April 13 will feature 21 seminars with nationally known speakers like Wayne Rash, contributing editor to BYTE; Jeff and Karen Acerson of WordPerfect Corp.; Mark Eppley, president of Traveling Software; Douglas Cobb of The Cobb Group; Richard Katz of Intuit Corp., and representatives from Apple, IBM, Borland, and AutoDesk.

The show will also feature 40 dealers, manufacturers, and publishers. Attendees can win thousands of dollars worth of door prizes.

Contact: Central Kentucky Computer Society, Inc., 2050 Idle Hour Center, Suite 160, Lexington, KY 40502; or "dreed" on BIX.

Organizers of the Trenton Computer Festival, a show with a long history, are now soliciting speakers. The festival, which will be held at Mercer County College on April 20–21, features a speaker program on a variety of topics, a flea market, and vendor exhibitions.

According to festival organizers, talks are grouped by topic area so that similar subject materials are discussed in the same set of rooms. Topics range from technical talks on languages, to presentations on computer music. Other topics include social issues and problems caused by the wide acceptance of computers.

Contact: If you are interested in making a presentation, Robert Todd, TCF '91 Speaker Chairman, c/o ACGNJ, P.O. Box 135, Scotch Plains, NJ 07076.

WordPerfect Comes in Several Platforms

WordPerfect Corp. is getting off to a big start this spring by offering several multiplatform releases and upgrades to its WordPerfect word processing software.

WordPerfect for Next compares to WordPerfect 5.0 for DOS in terms of features but takes special advantage of the NextStep graphical user interface (GUI). WordPerfect for Next features full WYSIWYG and lets you drag images from a graphics file into a document and place it within the text. Other features of the program include column customization and macro capabilities. WordPerfect for Next is compatible with WordPerfect 5.0 for DOS, and it will print to all Next-supported PostScript printers.

WordPerfect for Windows is compatible with version 5.1 for DOS, but it takes advantage of the Windows GUI. You can adjust your margins, tables, and columns with a simple drag and click of the mouse. With full WYSIWYG, WordPerfect for Windows lets you import graphics to text and see how they look.

You can display two subdirectories at once by using the program's split screen function. The Windows version of WordPerfect offers Dynamic Data Exchange, which lets you communicate between documents; you can import a spreadsheet into WordPerfect and "hot-link" it to the original spreadsheet. When you update the original spreadsheet, the information in the WordPerfect document will adjust accordingly.

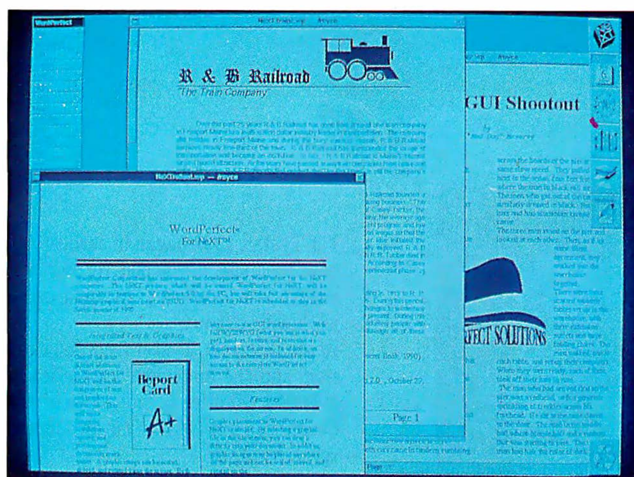
WordPerfect's Unix upgrade for the Sparcstation includes more than 40 new capabilities and support for OpenWindows and SunView. Version 5.0 of the program lets you scale and rotate graphics or place them anywhere on a page. You can scan images into WordPerfect documents or import them as graphics files. The Unix version features an enhanced macro editor. The new macro editor includes programming commands and a list of predefined macros. You can customize the keyboard by assigning macros or functions to particular keys.

WordPerfect 2.0 for the Mac features graphics and macro enhancements similar to those of the other platform upgrades with text boxes, draw overlay, and border capabilities. Version 2.0 has an expandable spelling checker and an on-line thesaurus. File formats in the Mac version are compatible with WordPerfect 5.0 and 5.1 across platforms.

Price: $495 each.

Contact: WordPerfect Corp., 1555 North Technology Way, Orem, UT 84057, (801) 225-5000; fax (801) 222-5077.

Circle 1203 on Inquiry Card.



WordPerfect for Next wraps text automatically as you import graphics and alter column sizes.

Mail Merge Added to Publish It! Easy

Mac users can use Timeworks' newly enhanced Publish It! Easy 2.0 to integrate word processing and graphics tools to create polished documents. The new software builds upon its predecessor by offering many new features, including support for mail merge.

Publish It! Easy 2.0 can automatically assign an appropriate text or headline font, depending upon the fonts you have installed. You can experiment with page layouts of one to four columns, and the program will automatically reflow the text and graphics. You can center, align, or space text without having to enter page dimensions.

Publish It! Easy requires a Mac with 512K bytes of RAM. A hard disk drive is recommended but not required.

Price: $249.95.

Contact: Timeworks, Inc., 444 Lake Cook Rd., Deerfield, IL 60015, (800) 535-9497 or (708) 948-9200; fax (708) 948-7626.

Circle 1199 on Inquiry Card.

Communicate with WordPerfect

WordPerfect Filter is designed to let users of Quicksoft's word processing software translate their work to other word processors in a few steps. In seconds, you can convert formatted text written in PC-Write or PC-Write Lite to or from WordPerfect and other WordPerfect-based programs. The filter translates common formatting commands, including rulers, end notes, and line spacing.

WordPerfect Filter requires an IBM PC.

Price: $19.

Contact: Quicksoft, 219 First Ave N, Suite 224, Seattle, WA 98109, (800) 888-8088 or (206) 282-0452; fax (206) 286-8802.

Circle 1200 on Inquiry Card.

Astronomical Improvements to Galaxy Lite

Starlite Software's Galaxy Lite 1.6 is a spiffed-up version of Omniverse Software's word processing package for DOS systems. New features include multiple document printing, a spelling checker, and a 70,000-word dictionary. You can choose between using menus or keyboard commands, and you also have the option of using a mouse.

Galaxy Lite 1.6 requires 256K bytes of RAM.

Price: $50.

Contact: Starlite Software Co., P.O. Box 370, Port Hadlock, WA 98339, (800) 767-9611 or (206) 437-0116; fax (206) 437-0117.

Circle 1201 on Inquiry Card.

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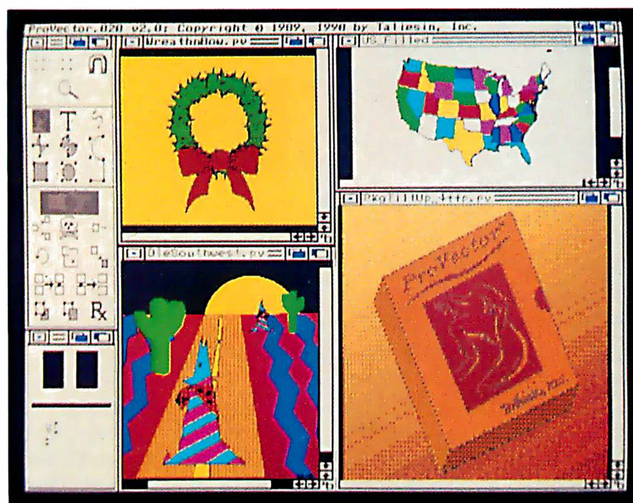
Circle 586 on Inquiry Card.

Structured Drawing for the Amiga

Taliesin says the new version of ProVector, a vector-based drawing program, includes multiple level undo, a complete layers system, and the ability to flow text to any path (e.g., a curve).

The program can import and export bit-mapped graphics and includes dithering routines for simulating 256 colors on-screen, even in 640- by 400-pixel interlaced format. You can select from a virtual palette of over 16 million colors on a 68000-equipped Amiga with 1 MB of RAM.

ProVector 2.0's interface lets you create complex artwork without requiring an underlying expertise in the mathematics involved in creating structured drawings, the company says. ProVector 2.0 includes a fast and accurate freehand drawing tool and easy-to-use Bézier curve tools.



ProVector 2.0 supports multiple windows, multitasking, and ARexx on the Amiga.

Output formats supported by the program include ProVector IFF-DR2D (Interchange File Format Draw two-dimensional), IFF-ILBM (Interleaved Bit Map), Hewlett-Packard Graphics Language, PostScript, and EPS. It can also create bit-mapped IFF paintings compatible with Deluxe Paint III.

ProVector 2.0 can plot structured graphics to super bit maps to create IFF files at the size you define, even several times larger than the highest-resolution screen. This lets you generate bit maps larger than 640 by 400 pixels.

The program runs on any Amiga with AmigaDOS 1.3 or 2.0 and 1 MB of RAM.

Price: $299.95.

Contact: Taliesin, Inc., P.O. Box 1671, Fort Collins, CO 80522, (303) 484-7321; fax (415) 256-1195.

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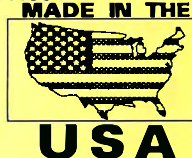
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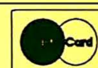
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Image Capture for VGA

Chorus Data Systems' UtilEyes video capture programs for the company's line of PC-Eye video digitizers can capture, display, and store images with up to 1024- by 768-pixel resolution from a video camera in TIFF, PCX, or TGA format.

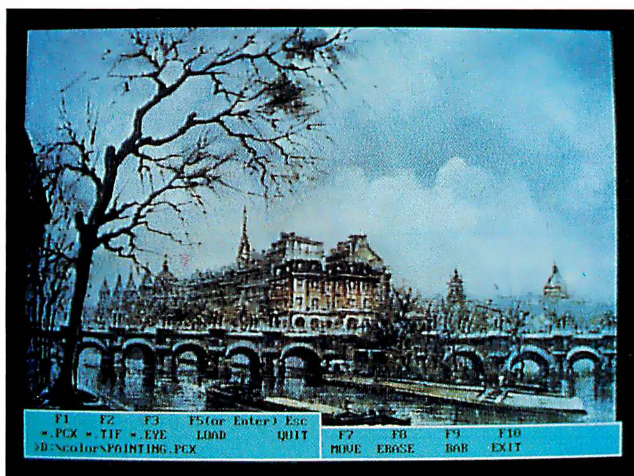
UtilEyes can capture up to 24-bit color images, which the program's algorithms then reduce to 256-color, 8-bit display for viewing on a VGA-equipped PC.

The family of video digitizers' capabilities range from capture speeds of 1/30 second for frame-grabber versions to ¼ second. Resolutions of up to 1280 by 1024 by 256 pixels are supported with the PC-1460 video digitizer.

Price: UtilEyes-Color, $199.

Contact: Chorus Data Systems, Inc., 6 Continental Blvd., P.O. Box 370, Merrimack, NH 03054, (603) 424-2900.

Circle 1193 on Inquiry Card.



With the UtilEyes video capture programs and Chorus Data's video digitizers, you can input images captured from a video camera into your desktop publishing or graphics program.

Picture Publisher for the Mac

Astral Development, developer of gray-scale and color imaging programs for DOS-based systems and Windows, now has a color version of Picture Publisher for the Mac. In addition to giving you hue, saturation, lightness, and color balance manipulation capabilities, the program includes built-in calibration features. With the calibration, you can adjust for inconsistencies.

Price: $695.

Contact: Astral Development Corp., Londonderry Sq., Suite 112, Londonderry, NH 03053, (603) 432-6800; fax (603) 434-6904.

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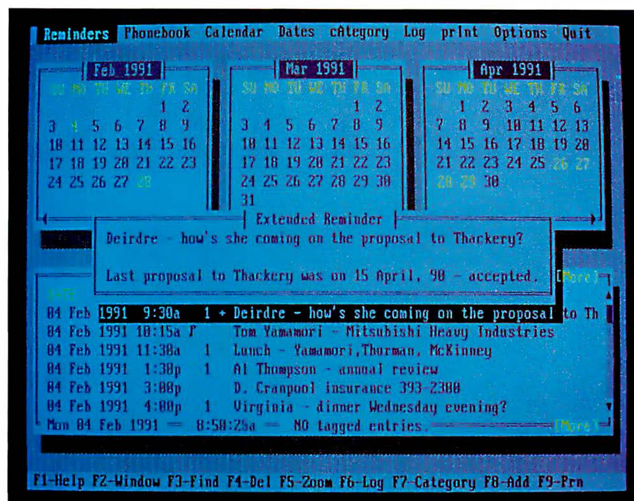
NEWS

PERSONAL INFORMATION MANAGERS

RAM Residency Added to Reminders

The Reminders! personal time management program, which combines an executive scheduler with to-do lists, alarms, telephone books, and other features, now offers RAM residency for pop-up access while in another program.

Other features added to version 3.0 include mouse support, word search for key names and phrases, warning messages indicating scheduling conflicts, notepads for extended entries, and auto-dial capabilities. You can create, view, and print a running list of appointments and other tasks for any given day, week, month, or other time period.



Reminders 3.0 lets you activate an extended reminder window from the main screen.

Reminders! 3.0 runs on DOS-based systems.
Price: $99.95
Contact: POP Computer Products, Inc., P.O. Box 1389, Evergreen, CO 80439, (303) 674-0200; fax (303) 670-6312.
Circle 1195 on Inquiry Card.

OnTime for Windows

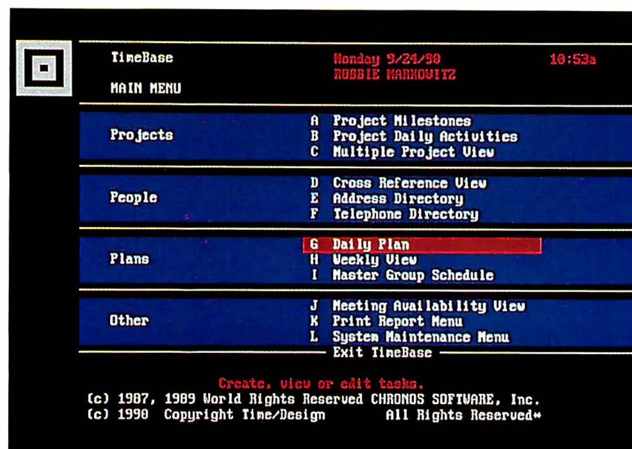
OnTime, the to-do list manager, scheduler, and reminder system, now runs under Windows 3.0. The program features a magnifying-glass tool for viewing the details of an appointment behing graphically displayed, blocked-out times. A week-at-a-glance screen displays your day in 60-minute, 30-minute, or 15-minute increments. The program supports one-time entry for recurring events.
Price: $99.95.
Contact: Campbell Services, Inc., 21700 Northwestern Hwy., Suite 1070, Southfield, MI 48075, (313) 559-5955.
Circle 1196 on Inquiry Card.

PIM for Project Management

The TimeBase program, a personal information manager for professionals, lets you schedule, prioritize, and delegate multiple activities. It includes a project management module. With the module, you can generate Gantt charts and milestones while viewing projects from multiple perspectives.

TimeBase includes a DOS gateway for moving directly into other programs, a memo processor, a pop-up calendar, and an alarm clock for reminding you of scheduled appointments. The program also has a calculator and mail-merge capability, a telephone address directory, and a mail list manager.

Price: $195.



TimeBase lets you organize the people, places, and things in your daily business life.

Contact: Time/Design, 11835 West Olympic Blvd., Suite 450, Los Angeles, CA 90064, (213) 312-0288; fax (213) 473-4941.

Circle 1197 on Inquiry Card.

An Organizer for Managers

Meca Software says The Manager's Organizer centralizes the mass of information that you need to organize so that you enter the same data only once. As you enter the data, the program transfers it to other modules.

The program includes time organizer, business card file, telephone log, personnel manager, expense report, automobile log, trip report, business calculator, and agreements modules. The personnel manager is for organizing employee information, records, job descriptions, goals and objectives, present and past reviews, schedules, vacations, and time off for employees.

Price: $249.95.

Contact: Meca Software, Inc., 327 D Riverside Ave., Westport, CT 06880, (203) 226-2400; fax (203) 226-2480.

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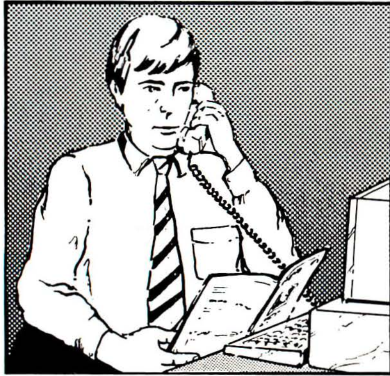


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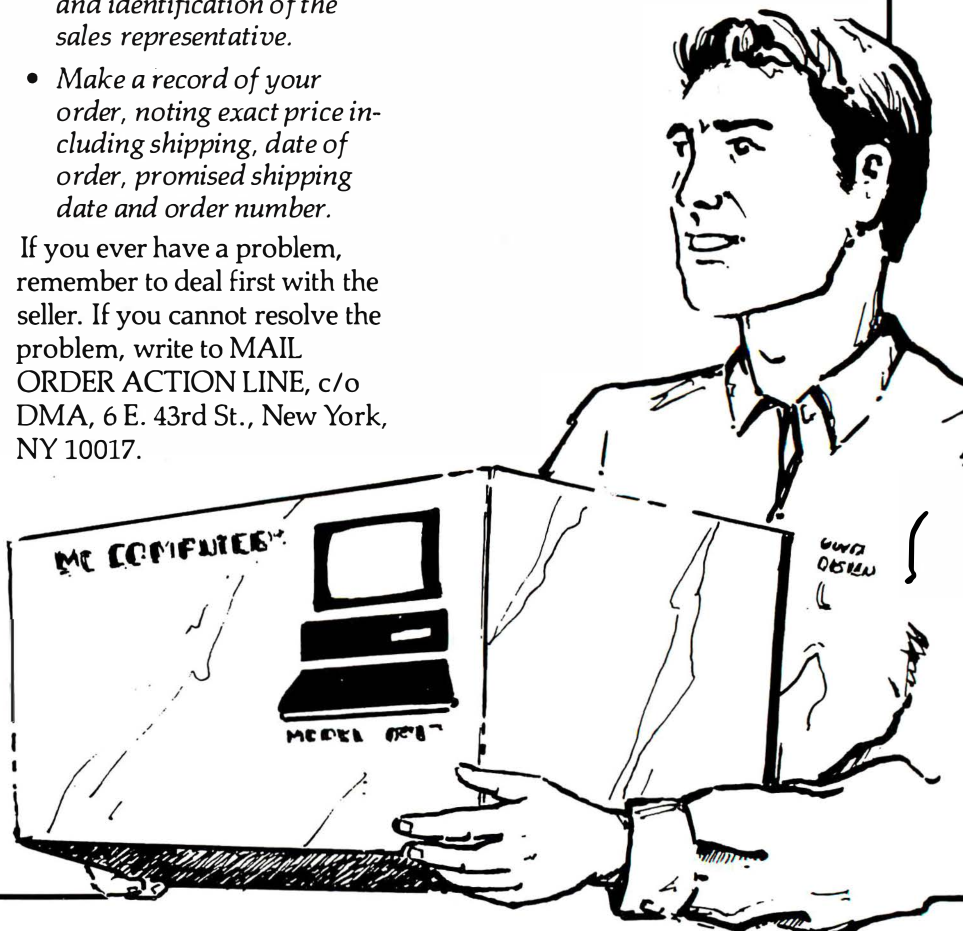
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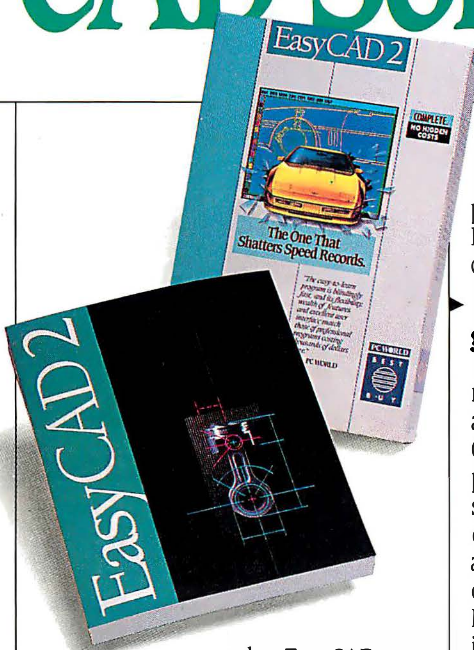
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1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

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7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

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10 ☐ Yes
11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)

12 ☐ PC/MS-DOS
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15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

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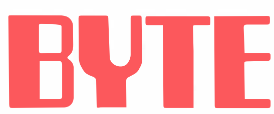


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B. What is your level of management responsibility?

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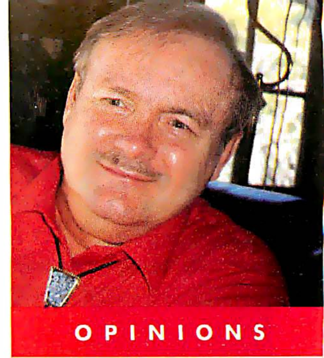
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JERRY POURNELLE

Desktop Publishing Fever

Every year about this time I get laid up with influenza, so this year I decided to get flu shots; alas, I didn't think things through. I got the shots just before this column was due; and the way the shots work is they give you a mild case of the latest variety of Asian flu. It's a lot better than getting the real thing, but it doesn't leave you in much of a mood to putter around with computers.

Add to that a bunch of deadlines—Niven and I are finishing *Fallen Angels* (Baen Books, July 1991) and *The Moat Around Murcheson's Eye* (Simon & Schuster, probably early 1992). Then I've got Steve Stirling's draft of Pournelle and Stirling's *Go Tell the Spartans* (Baen Books, spring 1991) to go over, and we're partway into *Hour of Treason*, the fourth Janissaries book. In a word, things are a bit tight timewise, as they say on Madison Avenue; meaning that I won't get to do what I'd intended, comparing the new Perceptive Solutions and Distributed Processing Technology hard disk drive controllers this month.

Of course, there's always something to write about. I keep hearing about this industry being in a slump, but you'd never know that from my mailbox.

Mac Business

The Los Angeles Opera League recently asked Roberta to do its newsletter, which means that instead of the president worrying about it in the middle of the night, Roberta will. The newsletter should be no problem with all the computing power we have here at Chaos Manor, but there's a small hitch: neither of us has ever done any real desktop publishing, and I don't have any time at all to learn, meaning that Roberta has had to make do on her own.

The first decision, then, was what machine to use. When I asked around, most people said that given the choice of PageMaker on the Mac versus Ventura Publisher on the PC, they'd take the Mac every time; and when we found that much of the text for the newsletter would be delivered in Microsoft Works for the Mac format, that pretty well decided it.

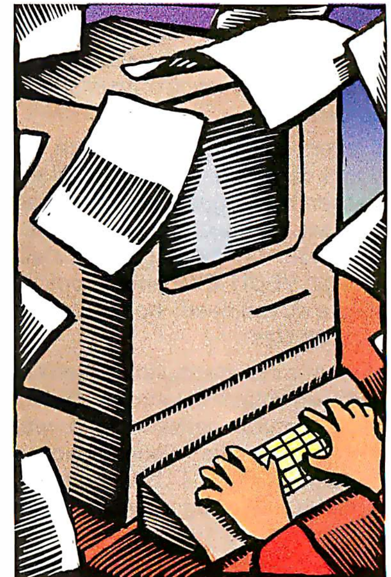
Alas, the first experiment was a near disaster: the Mac IIfx would keep crashing when we'd try to work with Microsoft Works. Converting to Microsoft Word helped a bit, but there were still unexpected things happening on the IIfx's screen, although the problems didn't seem to come up on the Mac SE/30. Time to stop and take stock.

Apple likes to get its latest and greatest equipment into the hands of reviewers as quickly as possible. While this is commendable, it sometimes results in our getting machines that are not quite identical to those the company later ships.

Meanwhile, Microsoft is notorious for quietly issuing unannounced software revisions: if they find that something doesn't work with new hardware, they fix it. If you ask them, they will cheerfully send you the revised copy, but they don't announce the revision. This practice makes sense, in that those who need the revision will eventually figure that out, while those who don't need it won't know to ask. However, it has the drawback that you can't always tell whether a problem is due to hardware or software.

Jerry helps Roberta tackle desktop publishing on the Mac and looks at simulation software

In my case, I had older versions of Microsoft Works and Word and one of the very first Mac IIfx machines sent out. The IIfx is a speed demon: it does things so fast that sometimes you can't believe it, and normally I love it, but I have had some very odd problems with it.



It's Virtual

For instance, we have never got Virtual, from Connectix, to work with the Mac IIfx. Virtual is a program that convinces your Mac that it has lots of memory. It does that by swapping from memory to a reserved area of your hard disk; this is a trick long used in minicomputers and mainframes but which, for some reason, has never appeared in the PC world and was late coming to the Mac. When we first got the program we had a Mac II, and Virtual worked fine with that. It works with the Mac IIci (which is a small version of the Mac II). Like a lot of good Mac software, it works invisibly, and it solves the "out of memory" problem forever.

Alas, though, it wouldn't work on the IIfx, which

ILLUSTRATION: RANDY LYHUS © 1991

was annoying because I have a couple of CD-ROMs that keep telling me they can't do their thing because I don't have enough memory. I'd have thought 4 megabytes was enough, but apparently some highly visual programs need a lot more. So it goes, but it was annoying.

There were other programs that would not work, even though the BYTE staff report they have no problems with them on a IIfx. So when Roberta began having problems, too, I decided enough was enough and induced Apple to swap out my old IIfx for a brand-new one right out of the warehouse. I also called Microsoft and asked for the latest and greatest of everything, and while I was at it, I sent to Aldus for the latest PageMaker.

If you must have computer communications and you travel to strange hotels, you should get Konexx.

The new IIfx arrived the other night, and I am pleased to report that we now have Virtual working. Sort of. To be precise, it will work with the IIfx and MultiFinder, but *not* with the new Macintosh Display Card 8•24GC. Put that card in, and Virtual goes higher than a kite.

The 8•24GC does 32-bit graphics, including 32-Bit QuickDraw. Not all applications will work with it, in which case you can turn off the acceleration and fancy 32-bit features and hope for the best; most software does work then. If worse comes to worse, though, we have to put in the old Mac video card.

For years, Apple told people not to use undocumented features—particularly not undocumented video features—in writing software. Unfortunately, many didn't listen, because the Mac's video was often slow, and software developers wanted their stuff to sparkle. Now that Apple is implementing the full standard (which they have published for years), a lot of older software is crashing. Some companies are putting out unannounced revisions. Others are just plain in trouble. We have not heard the last reverberations from this.

Meanwhile, Roberta has been going great guns with the newsletter. She converts the files from Works to Word and edits in Word. When things are properly proofread, she squirts them into PageMaker. She's been experimenting with fonts, and shadowing, and various visual effects, and the newsletter already looks pretty good.

She figures this issue is experimental, and the next one will be more definitive, with illustrations and such. The first illustrations will probably be from the extensive collection of T/Maker ClickArt: there are numerous drawings from the worlds of sports, business, art, cartoons, religion, and patriotism, all easily incorporated into documents. More on this in the future.

Ventura Publisher

Jim Baen is treating *Fallen Angels* as his big book of the year, with lots of promotion. One device he has hit on is a chapbook—in this case, a 70-page perfect-bound book in trade-paper size and format. The chapbook has the actual *Fallen Angels* cover and the first three chapters of the book. It will be sent to reviewers, bookstores, and science fiction fan conventions.

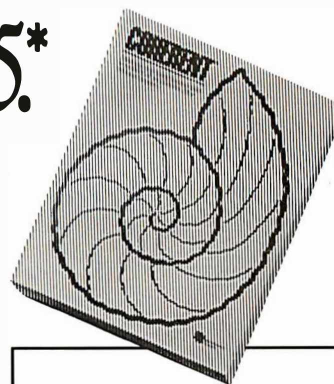
What makes it worth reporting here is that the whole thing was conceived and designed in my conference on BIX, in which experts told Jim exactly what hardware and software he needed to get this done and a good bit on how to do it.

The chapbook was produced on Jim's Northgate 386, formatted in Ventura Publisher using Bitstream's Baskerville font, and printed on a Hewlett-Packard LaserJet III; and the result is beautiful. Past systems of desktop publishing, especially with PC-based (as opposed to Mac) systems, have produced pages that aren't quite professional looking. The letters tend to be too thick, or else they break up and look patchy. Not so in this case. Even viewed with a strong magnifying glass, the chapbook's letters are continuous, and the pages look as good as any typesetting job I have ever seen.

Baen said it took him about 6 hours to go from the electronically readable text to the page proofs. Part of that time was spent doing proofreading and minor line editing. This was done in XyWrite. He then fed the text into Ventura Publisher; if global replacements were needed, it was simpler to go back to XyWrite and make them and read it back in again.

continued

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Eventually, he had everything right and printed master copies on the LaserJet III; and it all came out very well indeed.

The implications of this reach a long way. Within a few years, I suspect most books will be typeset in the editorial offices rather than sent out. Moreover, it's now possible for authors to furnish camera-ready copy and thus have near-total control over their works. That will not happen quickly—indeed, perhaps it *shouldn't* happen quickly, because some editors, such as Baen, can significantly improve a work—but it's inevitable. Now that desktop publishing can produce true professional quality, there are just too many advantages for editors and publishers not to use it in book production.

PowerTrip

On Thursday, July 11, about noon down in Baja California near Cabo San Lucas, there will be a full eclipse of the sun. There will be several minutes of totality; indeed, this is going to be about the best eclipse for 25 years or so. I'm on the board of the Lowell Observatory, and they may be sending some people also; but whatever they do, I don't intend to miss the best eclipse of the century, so Niven and I will be driving down in the Ford Bronco II.

One gadget that will go along will be the PowerTrip converter from Zirco. This is a gizmo that plugs into your cigar lighter and delivers 100 watts of 115-volt AC power. It works just fine; I've used mine for over a year now, and some of that was pretty heavy use on roads at least as bad as the modern Baja Highway. (It's much improved since the early 1970s, when Sarge Workman and I went down the *old* Baja; 1000 miles of Very Bad Road.)

My normal lash-up is to plug PowerTrip into the Bronco's cigar lighter, plug the 110-V converter for one of the portables into that, plug the output of the portable's power supply into the portable's battery, and, leaving the battery on the floor so it isn't crushing my lap, run a cable from the battery to the portable. This gives me a machine running on an uninterruptible power supply—the portable battery—while running everything off the car system. Moreover, if I ever want to use a car fax machine on the car phone—I never have, but I suppose it might happen someday—I can unplug the portable and run the fax machine off PowerTrip.

It's amazing how often I need 115 V in my car. I'm sure we'll make use of it on the Baja trip.

PowerTrip has earned a User's Choice Award. Recommended.

Konexx

One hazard of trips is the hotel telephone that's hard-wired so that you cannot connect your modem. Over the years, we've all developed tricks for dealing with that. Often, for instance, the connection to the phone itself is hard-wired, but the wall connection is a modular connector, probably with a plastic part broken off so that you have to use a nail file to get the cord out of the wall. Sometimes, though, you just can't get at the phone connections at all; at which point, you may in desperation resort to taking the phone apart and using alligator clips.

Konexx is a new weapon in the ceaseless battle between computer users and silly hotel people. It's a small box, considerably smaller than a pack of cigarettes, that plugs into the telephone's

handset connection. Once that's done, you have two connections, one for the handset itself and the other for your computer. There are switches to control polarity and telephone type and to switch between voice and data. All that is explained simply in the documentation.

I've had Konexx in my portable computer kit for several months now. Fortunately, I've never had to use it, but I have tested it a couple of times: it works, and it beats hell out of acoustic couplers. Konexx works for ordinary modem communications or fax. If you simply must have computer communications and you travel much to strange hotels, you need this.

Konexx gets a User's Choice Award. Recommended.

Operations Research

The modern discipline of operations research (the British call it operational analysis) began in World War II when British mathematicians studied antisubmarine warfare tactics. The results were pretty dramatic: by looking at the effectiveness of different tactics then being employed—analyzing different operations—and making mathematical models of such things as search and attack patterns, they were able to recommend tactics that increased combat effectiveness by a factor of nearly two. This was important to the war effort, and for a while OR was thought to be the key to a great number of industry and social problems.

Indeed, OR has become a standard academic discipline with its own advanced degree programs. There is also systems analysis, but as far as I can tell, that's only a fancy name for OR; the best I can tell, systems analysts do about the same things as practitioners of OR—namely, gather a bunch of observational data about a problem, build a mathematical model of what they think is going on, and solve the model to optimize a particular criterion of success.

Systems analysis got into bad repute during the 1960s, when then Secretary of Defense Robert S. McNamara employed his "whiz kids" and what was said to be systems analysis on the Vietnam War. The result was a disaster, and to this day, many military commanders are horrified at any suggestion that systems analysis should be applied to their operations. In fact, though, it's unfair to blame the discipline for its misapplication—and it was very much misapplied.

One of the first things they teach you in OR is to *select the proper criterion*. As an example, in the World War II situation, the really important criterion was *not* the number of German submarines sunk, but the amount of allied shipping that got through to England. Now those numbers correlate, but not perfectly; tactics that tended to break up and thwart the German sub attacks often worked better than tactics that maximized the number of subs sunk.

In Vietnam, criteria were selected because they were easy to measure. It's a lot easier to get a body count than to determine your degree of control over a village. It's a great deal easier to determine the sortie rate of an Air Force unit than it is to determine just how effective those planes have been. Couple that with McNamara's unreliable data, and you have a formula for disaster; but you haven't discredited OR or systems analysis.

Models

The value of OR and systems analysis is not so much in making models—all

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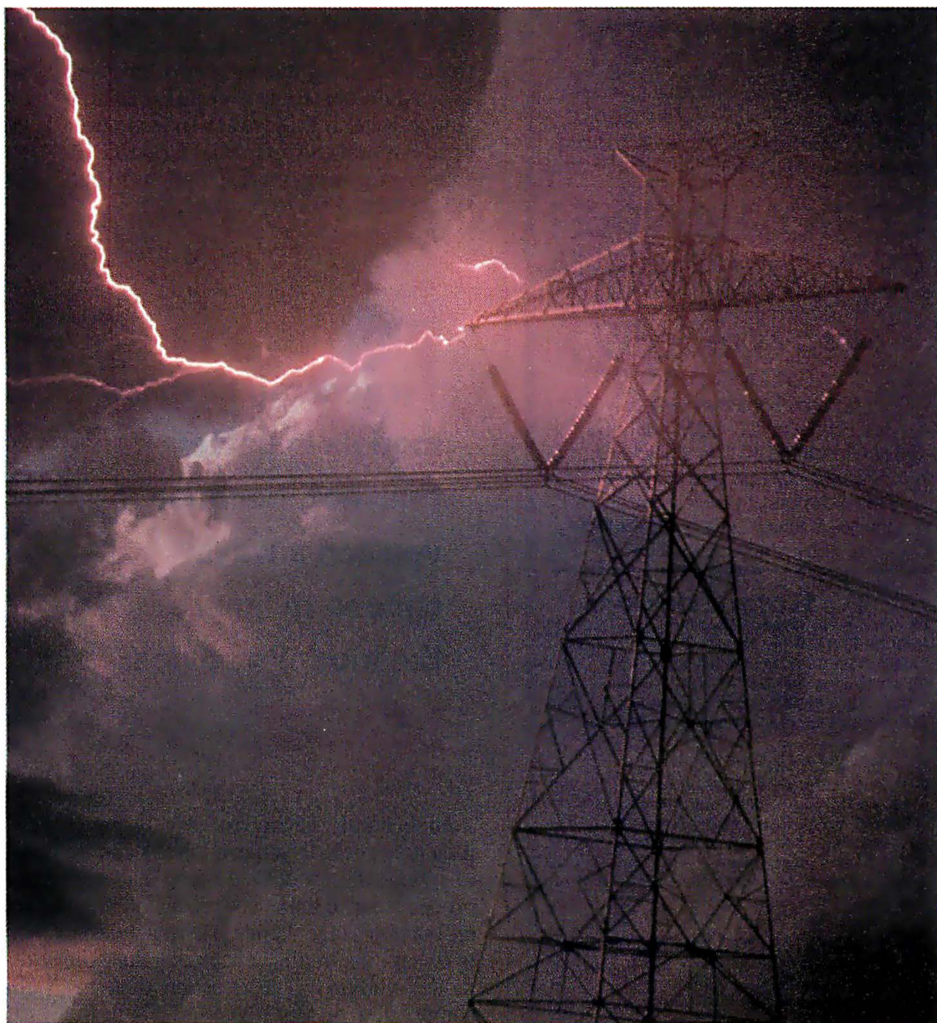
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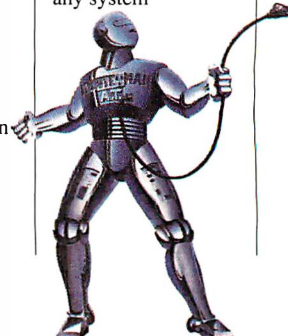
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science does that—but in making your policy assumptions explicit. If, during the Vietnam War, secrecy had not prevented outside criticism of the inappropriate models employed by the whiz kids, simple sanity would have asserted that maximizing the number of missions flown didn't have any necessary relationship to winning the war. Indeed, even crude modeling often is valuable in showing up mistaken assumptions to outside critics, if not to yourself.

In general, having models is better than not, because you can always choose to ignore the model's advice.

In general, having models is better than not, because you can always choose to ignore the model's advice. The best procedure is to make your decision models but don't take them too seriously: that is to say, use reality checks against the model's advice. The question then becomes, how do you make models in the first place?

How to Model It: Problem Solving for the Computer Age by Anthony M. Starfield, Karl A. Smith, and Andrew L. Bleloch (McGraw-Hill, 1990) is a serious attempt to teach modeling. It does that through a kind of Socratic method, requiring considerable work on the part of the reader; but since that is probably the only way to learn, it's a good approach. Whether readers outside a classroom setting—I'm sure this book was written primarily as a text—will do the exercises is another matter, but it is very much worth the effort. Some of the problems are hilarious, some serious; they're all fairly well chosen.

I have some reservations about this book, but let me quickly say it's the best thing I've seen on the subject. Get this book, and something like Extend for the Mac or *Interactive Dynamic System Simulation* (either the educational edition, which includes the Desire program, from McGraw-Hill or the professional version, available from G. A. and T. M. Korn, 6801 Opatas St., Tucson, AZ 85715) for the PC, and spend some serious time with it. When you've finished, you'll know as much about modeling as I did when I first got into the systems analysis business over 30 years ago.

Balance of the Planet

All of which is introductory to reviewing Chris Crawford's Balance of the Planet, which is sold as a PC or Mac game but functions better as a relatively serious simulation, worthy to be ranked with Jay Forrester's World Dynamics Model. (Incidentally, the Forrester model is available in *Interactive Dynamic System Simulation*.)

What Crawford has done is to make an explicit model of the relationships between research; family-planning subsidies; energy demands; taxes on coal, oil, and nuclear power; agricultural practices; global warming; quality of life; and some 30 other factors. The player is assumed to have become Czar of Earth, with the power to set taxation and research policies. Once those are set, the policies are implemented and the results calculated. They will generally be bad news for the player. Left to themselves, things get much worse, and quickly.

They don't get a lot better if you start making changes, either. Everything you do affects something else. About the safest tax you can levy is a hefty one on beef (thus releasing considerable grain to be distributed to the poor); but, of course, that one affects quality of life for the industrialized world.

The key thing about Crawford's game, though, is that you can get at the assumptions. Suppose you don't believe that nuclear waste is a problem. You can go into the model and change the equation that relates danger to nuclear waste. There are many other such options. Not, I hasten to say, as many as I would like. For example, if there's a way to factor in a vast increase in resources brought about by a big investment in off-world mining—lunar strip mining—I haven't been able to figure it out. Similarly, while there is an equation relating the effectiveness of family planning to quality of life, it doesn't do precisely what I want, which is to reflect the historical relation of family size to wealth (rich countries historically do not have many children).

Despite all my reservations, though, Crawford has done something few others claiming to be concerned about the environment have done: he has made his

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assumptions explicit, while giving those who disagree the chance to make changes in his model.

The game/model is implemented as a series of HyperCard-like stacks. This makes for a uniform and simple user interface; alas, it also makes it tedious. You can call up a screen of policy choices and view them after a fashion, but to change one, you must call it up (click on it) and put it away again. I got weary of that after a while, but it does get the job done. Moreover, by studying how Crawford has used HyperCard stacks to make his model, you can see how you might create your own.

About the time I'm tempted to give up on the Mac, there comes along something like I Think.

Crawford has done a lot of work on this. I question a number of his assumptions—but the point is that he has put those assumptions out front where you can see them. I can always try to do better, first by working within the limits of Crawford's model, and then, if I think I have identified factors he has overlooked or omitted, by making up a brand-new one of my own incorporating the parts of his that I agree with. Either way, one can learn a lot by playing with Balance of the Planet.

You will note that although Balance of the Planet is published as a game, I have reviewed it as a simulation. As a game, it's not much fun. There aren't any fancy graphics and special effects like you will find with SimCity and SimEarth or the new Powermonger. Mostly what happens is that a screen comes up to tell you that you've blown it again, so that unless you're passionately interested in the subject—in a word, unless you think of this as a simulation rather than a game—you'll get bored fast.

However, if you're interested in models and simulations, get this and look at it while you go through the exercises in *How to Model It*. When you're done, you'll know a lot more about models, and you'll be about as ready to tackle the problems of the global environment as a *lot* of experts I've heard blather on the subject. At least you'll know what you believe and why.

I Think

The Mac drives me crazy. Before we swapped machines, I copied everything that was on the old Mac IIfx's internal hard disk drive into a folder called "Old Boot" on the (external) Priam 330-MB hard disk drive. Then I connected up the new Mac IIfx and the Priam drive.

Fine, but there's a problem: my old Mac IIfx had a slew of fonts and a sizable number of desk accessories. They're not on the new one, and all my efforts at fooling with FONT/DA Juggler and Installer and whatnot have produced no results at all. As usual, the help messages are clear only if you knew what to do in the first place. I'm pretty sure that everything is on that Priam drive somewhere—where else could it have been?—but I can't figure how to get it off there and into use.

With a PC, I'd just copy files, but with a Mac that won't work. Eventually, someone will tell me, and I'll feel a bit sheepish; but don't ever let people kid you that a Mac is all that intuitive, particularly when it comes to software—including system software—provided by Apple.

It's probably just me. My son Frank has no regard for computers; to him, they're just tools. He grew up with these little machines, and as soon as he had a choice, he glommed onto a Mac. To him, a Mac, Excel, WingZ, and Microsoft Word are the minimum requirement for business. (Actually, they're nearly the maximum as well, as far as I can tell: certainly 95 percent of his computer time is spent with one or another of those, with WingZ for graphics effects and Excel for spreadsheet power.)

As for me, about the time I'm tempted to give up on the Mac in disgust, there comes along something like I Think, billed as "The Visual Thinking Tool for the 90's." This is a program that creates "visual spreadsheets." All spreadsheets are "visual" in one sense, but what I Think makes is spreadsheets with a visual representation of the relationships among the cells.

The result is that it's relatively easy to use I Think to create models similar to Crawford's Balance of the Planet or

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For prospective clients wishing to enter the field, we have prepared a pilot system, enclosing in one package the full range of functions necessary for electronic filing. The system components are:

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386 base micro-computer at 33MHz with 64K cache, 8 MB RAM, 1.2GB with access time of 0.8MS (disk caching), proprietary scanner and printer interfaces, high resolution (1660 x 1200) CRT display, laser printer 300 dpi at 8 ppm, scanner 300 dpi with 100 page feeder.

Software

The EEF software package, including the document manager, the retrieval engine, the hypermedia interface, and 20 hours of customization services.

Total cost for the pilot system is 30,000 US$.

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125-127 North 4th Street Philadelphia, PA 19106 USA Tel. + 1 215 627 7202 Fax. = 1 215 627 2342.

Forrester's World Dynamics Model. Moreover, I Think comes with some good tutorial materials to lead you from simple financial spreadsheet models to complex systems analyses. There are also sample systems.

Now that Windows is catching on, I expect to see a spate of programs like this for the PC; meanwhile, though, Mac users interested in learning modeling will find this a good introduction, especially if used in conjunction with the previously mentioned *How to Model It*.

Chinese Chess

Interplay Productions' Battle Chess for the Amiga was gorgeous. Battle Chess II, graphical Chinese chess for the IBM PC, is no less so. Alas, the first version they sent me died horribly if used with a Microsoft Mouse, but they've fixed that. If you have a Microsoft Mouse, be sure to get the latest version, because otherwise it not only won't work, it will lock up your system.

The chess-playing software isn't very efficient: even on the Cheetah 486 at the lowest player level, the program takes an awfully long time to think; but then you don't buy this program for that. The software is good enough to teach you Chinese chess—and the graphics are beautiful. Knights swagger, wizards turn into dragons, soldiers fight with spears....

Interplay has made their copy-protection scheme as unobtrusive as they can: you give the password out of the manual on setup and don't have to again as long as you are playing the game on that machine. The bad news is that if you fail to give the right password at setup time, they lock up your system to hardware reset level; which to me is at the edge of unacceptable.

Battle Chess II uses a *lot* of memory; you'll want at least 540K bytes free. It sure is pretty.

NewsViews

A very long time ago, my father owned radio station KCLX in Colfax, Washington; so when I recently got a letter from Tribune Publishing, which, although they're headquartered in Lewiston, Idaho, publishes the *Colfax Gazette*, I paid more attention than I might have otherwise.

What they were announcing was a new archive program: one that will store on disk not only the text of their (or your) newspaper, but also pictures and graphics. NewsViews uses Windows 3.0 for display and employs a compression system to reduce file size. While I'd imagine this would be best suited to high-capacity optical drives like a WORM (write once, read many times), you can get quite a lot of data on a hard disk. NewsViews creates an index and appears to have highly efficient search algorithms. The result is total archiving and indexing of every issue of the newspaper.

I can't claim to have used this enough to be an expert, but if you've got the problem of archiving and retrieving a lot of text, with or without graphics, this is worth looking into. As they say, they use it themselves.

Virtual Park

Damon Runyon said that horseplayers die broke, and I expect it's true, unless you can confine yourself to virtual bets; which should be simple enough if you do all your racing at a virtual racetrack.

Virtual Park stables 120 horses. There are 12 trainers and 15 jockeys. It keeps

track of all the race statistics, handicaps, performances, and suchlike, and then arranges horse races, which it shows on-screen. Since I'm not all that fascinated with horse racing to begin with, this isn't my cup of tea; but I must say it's interesting to see just how complex horse-racing statistics and handicapping can be. If I ever did want to learn something about the Sport of Kings, I expect I'd start here.

The Electric Chemistry Building

I have previously mentioned Inorganic Chemistry from Snowbird Software. They now have more, including Physical Chemistry. With this program, you can conduct experiments on gas laws and changes of state; chemical reactions that depend on bubbling gasses into solutions; acid-base titrations; electrolysis; and other such aspects of physical chemistry.

As with the Inorganic Chemistry lab, Physical Chemistry is a model of a chemistry laboratory, complete with titration devices, gas bubblers, electrochemical cells, and a stock of chemicals. In the program, you "go get" chemicals, put them in various containers with other chemicals, and do things like heat them or apply electrodes.

The program runs the experiment, and you see results, such as gasses bubbling out or the electrode eaten away. All told, it's a much cheaper way to do experiments than in a hands-on lab. Of course, you don't learn as much as you would in a real lab, but it's surprising just how much fun you can have puttering around with virtual chemicals.

I do think students ought to have real laboratories for some of their work; but you can do a lot more virtual experiments than you'll ever manage with the real thing, and there's a lot to be said for having that kind of experience. I wish we'd had these programs when my boys were taking chemistry in school. For that matter, I wish I'd had them when I was taking chemistry. Recommended.

All ChargeCard

If you have a 286 you don't know what to do with, here's the right upgrade. I've used the All ChargeCard on a few older machines, and I have reports from some other users, including the person at White Sands Missile Range who has the job of updating a bunch of government-model Zenith 248s. This works.

The All ChargeCard memory management unit will in essence turn your old AT into a 386SX capable of loading TSR programs into high memory and generally doing things in a modernized way. Installation is simple enough, and once done, the revision is pretty well transparent to you. You will then have expanded as well as extended memory and memory management capabilities, so that your older machines will run Desqview and Windows with no problems.

All Computers makes All ChargeCards with various adapters to fit most 286 AT machines, including clones. It's probably best to check to see what adapters, if any, you'll need. Otherwise, I don't see why you would have any trouble with this. If you've got an AT, get this; it will make the old soldier useful again. The All ChargeCard gets a User's Choice Award. Recommended.

CD-ROMs

I've got a whole stack of CD-ROMs for both PCs and Macs. Increasingly, the

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Model CC2/P $299
Model CC2/F $349
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Balance of the Planet $49.95
Accolade Software
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Organic $299.50
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Model 108 .... $139
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Virtual Park $32.95
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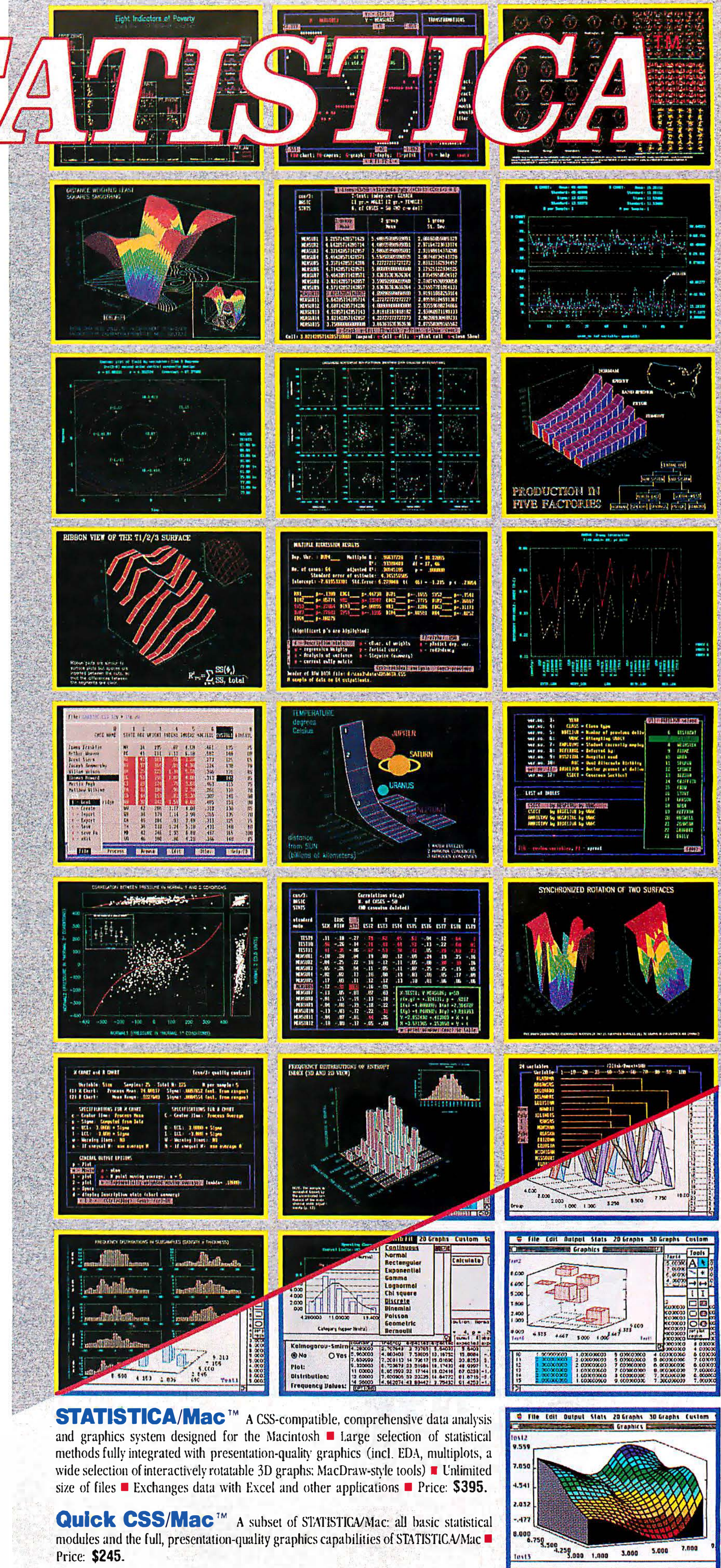
same CD-ROM works with either machine, with only the retrieval software being different.

We have BiblioMed from Healthcare Information Services, which is a quarterly updated biomedical bibliographic database indexed in nearly every conceivable way. About three years' worth of some 500 medical journals are stored on the disk. Unfortunately, the only CD-ROM driver software supplied is for Hitachi (including Amdek), Toshiba, Sony, and Philips machines; I couldn't get it to work with the Pioneer multiple CD-ROM player. If you do have one of the drives it works with, the indexing is excellent, and the coverage looks good to me.

One neat feature is the ability to extend your search on-line to MEDLINE if you want to find something that's not in the BiblioMed database. You can thus read at leisure from the CD-ROM and then get the absolute latest and greatest updates on-line, which should save considerable money.

I'm not competent to judge which of the different medical CD-ROM bibliographic databases is best; but I do think this is a good example of the wave of the future, and every hospital and clinic

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ought to have BiblioMed or something like it.

Another CD-ROM is from Quanta Press: North American Fax Book. This is a list of every known fax number as of press time. It comes with a slip of paper announcing, "The fax number for the embassy of Iraq has been changed due to circumstances beyond our control." One wonders just how far a tongue can go into a cheek. In any event, it's worth having Quanta's catalog.

This is the year CD-ROM came of age. There are increasing numbers of CD-ROM products, ranging from highly specialized to general educational to highly amusing. Meanwhile, CD-ROM readers are getting cheaper, and even more important, *faster*. Software that does intelligent caching is being developed. If you don't have a CD-ROM on your system, you should think seriously of getting one: you just don't know what you're missing.

Systat

I just received both Mac and PC versions of Systat 5.0. When someone on BIX said he had collected a mess of data and now needed some way to analyze it, I told him to run, not walk, to his software house and get the latest version of Systat. That advice still holds: if you have any requirement for statistical analysis—and more important, perhaps, if you only suspect you do—get Systat.

It will not only do the job, it will help you figure out what job it is you wanted to do. I wish they'd make every social science student learn to use Systat; we'd have a lot fewer silly recommendations to bombard us. User's Choice Award. Highly recommended.

Winding Down

The books of the month are Paul Johnson's *Intellectuals* (Harper & Row, 1989), which is certainly his most important work since *Modern Times* and may be his best ever: readable biographies of intellectuals who shaped our modern world and considerable thought about what they have wrought. The other is Colleen McCullough's *The First Man in Rome* (Morrow, 1990), about Marius and Sulla. McCullough's *The Thorn Birds* was number 1 on the best-seller list when our *Lucifer's Hammer* hit number 2—and, alas, she stayed there, as did we, for 14 weeks; I sure wish she'd written it just a bit earlier or later. In any event, *The First Man in Rome* is the best historical novel I've read in years.

The computer book of the month is *Microsoft QuickBASIC Bible* by Mitchell Waite and others. It's a complete one-volume reference that includes an excellent discussion of variables, typing, and the environment: the book should come with the language itself.

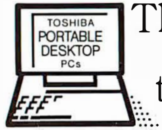
Next month, with any luck, I'll get to the hard disk drive controllers. At least I won't have the flu. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

IT HAS BEEN
BROUGHT TO
OUR ATTENTION
THAT NOT EVERYONE
BELIEVES
PORTABLE PCs
CAN BE AS
FUNCTIONAL AS
DESKTOP PCs.



THIS SHOULD



This may be hard to believe, but there really is such a thing as a portable PC that can do everything a conventional desktop can.





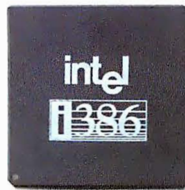
Some people can't imagine squeezing a 40,100 or even a 200MB hard disk into a portable PC. But when they take advantage of all that storage capacity, they find it hard to imagine life without it.

In fact, there's not just one, but an entire line of them. They're called Toshiba Portable Desktops,™ and they'll forever change the way your company looks at power and productivity.

To get more information or a free Portable Desktop productivity survey, call 1-800-477-1616.

True, some business people may have trouble grasping the notion of desktop power in a portable, but when you give it some thought, it's the next logical step in computers.

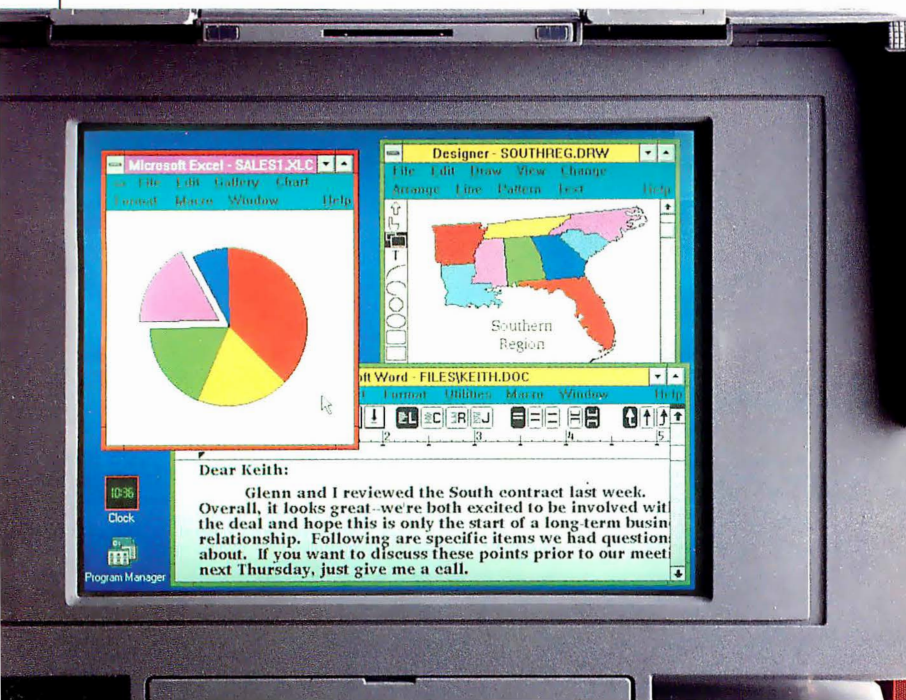
There once was a day when microprocessors this powerful were unheard of in a portable. Luckily for people who crave raw power and computing speed, that day is over.

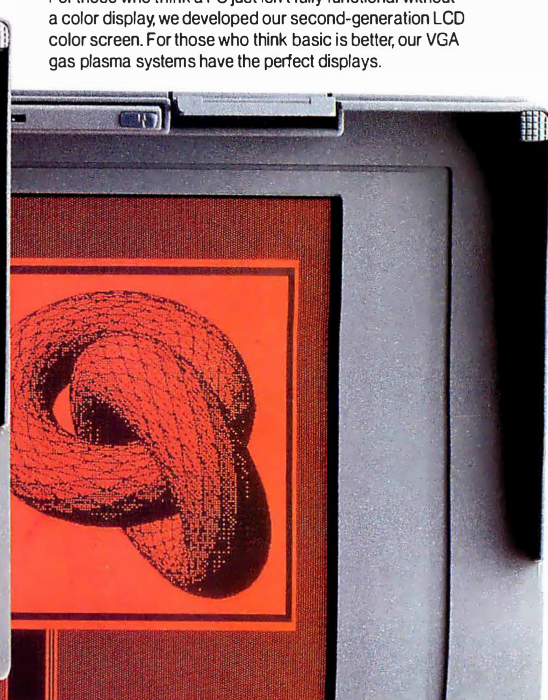




With 386™ and 386™SX microprocessors, our Portable Desk-

For those who think a PC just isn't fully functional without a color display, we developed our second-generation LCD color screen. For those who think basic is better, our VGA gas plasma systems have the perfect displays.





REMOVE ALL DOUBT.




To anybody who doesn't expect a portable PC to have IBM®-compatible expansion slots, we have just one thing to say. Raise your expectations.

tops run all of the same applications as your company's conventional PCs.

With hard disk drives from 40 to 200MB, you have all the flexibility to configure a system the way you want it.

With the connectivity of our multiple expansion slots and ports, our Portable Desktops fit right in with your existing system and grow as your company grows.

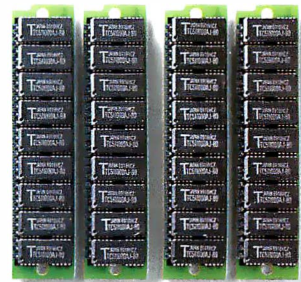
And to remove the last possible barrier between your needs and our portables, we've even designed one with a high-resolution VGA color screen.

In other words, it really is possible to have all the capabilities of a conventional desktop in a portable.

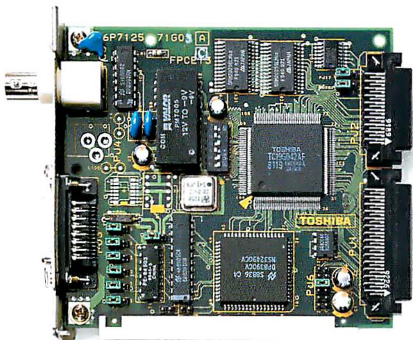
All you have to do is try one. And believe.



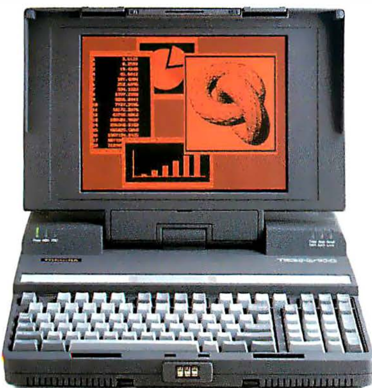
Anyone who insists portable PC users are doomed to cramped, undersized keyboards hasn't gotten their hands on a Toshiba. We use standard-size keys and standardized key spacing so your hands will feel right at home.



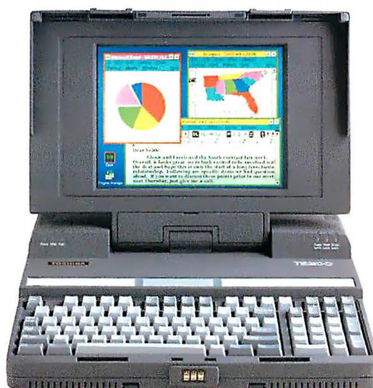
They say you can't squeeze much memory into a portable PC. But considering that our dedicated memory expansion slots let you add up to 12MB of RAM as your need for power grows, it looks like "they" were wrong again.



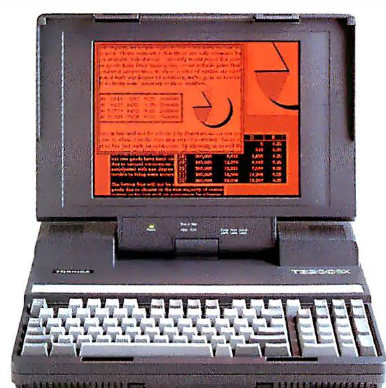
With an expansion slot for a LAN card, you get complete networking freedom without giving up all your other expansion slots.



T5200. 386 microprocessor, 40, 100 or 200MB HDD, 2 to 14MB RAM, 2 IBM-compatible expansion slots (in addition to dedicated memory slots), VGA plasma display.

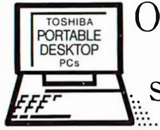


T5200C. 386 microprocessor, 200MB HDD, 2 to 14MB RAM, 2 IBM-compatible expansion slots (in addition to dedicated memory slots), VGA passive matrix color LCD display.



T3200SX. 386SX microprocessor, 40 or 120MB HDD, 1 to 13MB RAM, 2 IBM-compatible expansion slots (in addition to dedicated modem and memory slots), VGA plasma display.

NOW THAT YOU'RE CONVINCED,



Okay, let's suppose you suddenly discover your company filled with powerful Toshiba Portable Desktops.

Now what?

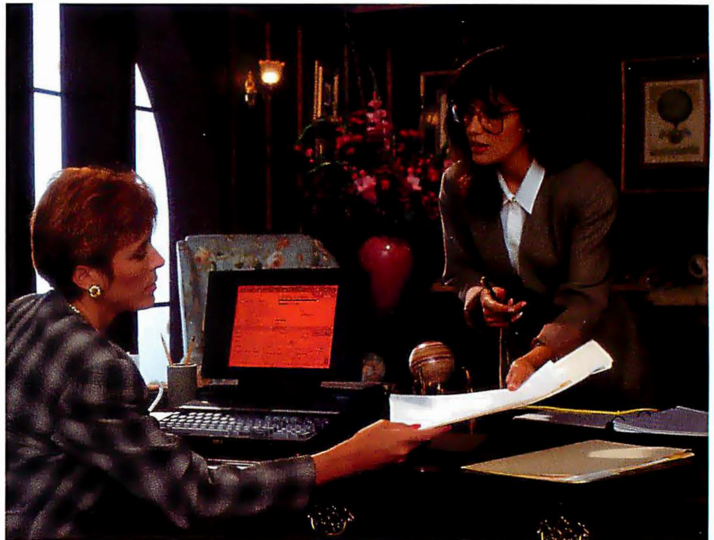
First of all, your people can do everything around the office they've been doing with their desktop computers.

Then your key employees can turn after-hours time into productive time, since their dining room tables and breakfast nooks can serve as off-site workstations.

Your top people can add impact to their presentations with a wealth of information and computing power at their fingertips. And the story can repeat itself—with equally impressive results—everywhere from an office 3,000 miles away to a conference room that's a mere 30 feet down the hall.



Giving your people instant access to vital information can keep them doing what they do best. Working smart.



Employees can even improve their productivity in the familiar surroundings of their own office. Only now they'll have more desk space to work with.

To get more information or a free Portable Desktop productivity survey, call 1-800-477-1616.

WHERE DO YOU GO FROM HERE?



Giving your key employees a Portable Desktop means they'll have the flexibility to work when they need to, where they want to.





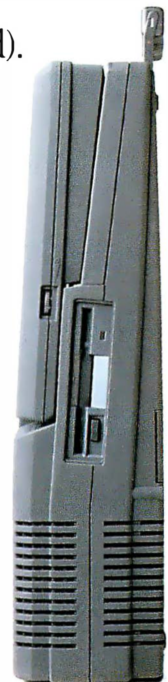
When people have access to computing power outside their office, presentations are more powerful and groups are more productive.

And yes, all that productivity can even take place within the confines of your own office desk (while using up considerably less of your desk space, we might add).

All of which leads us to one very powerful observation.

Now all of your best people can be doing a better job than they ever could when they were chained to conventional desktop PCs.

Better yet, they can do it without sacrificing power, functionability or expandability. Or anything else, for that matter.



THREE POWERFUL ARGUMENTS WHY YOUR NEXT



People said it was just a matter of time before someone built a line of portable PCs this powerful. They just didn't know it would happen so soon. With our Portable Desktops, we've successfully combined the power and functionality of desktop PCs into slim, portable packages that give you everything you need to get ahead in business.

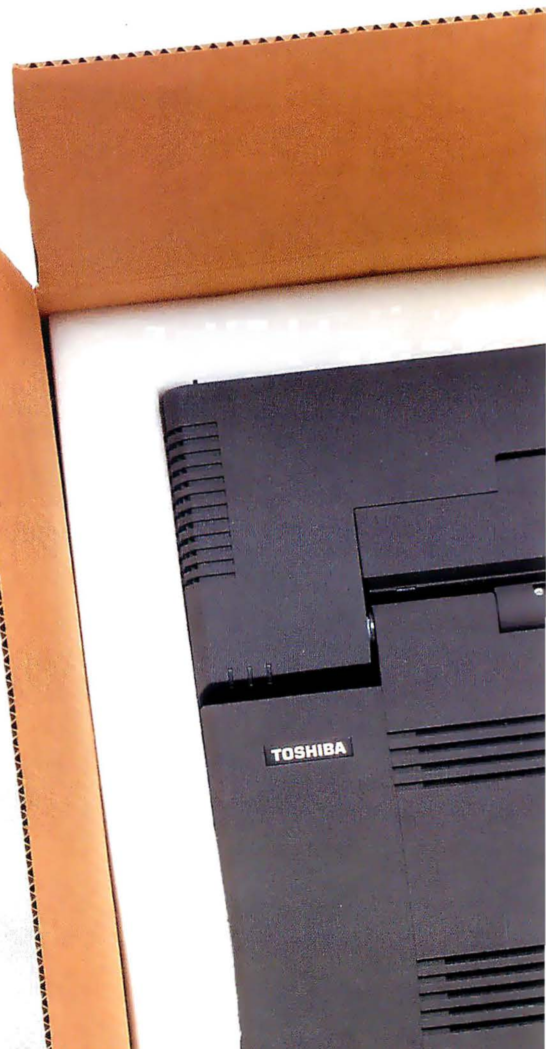
T5200

18.7 pounds, 20MHz 80386 with 80387-20 coprocessor socket, 2 internal IBM-compatible expansion slots, 40MB hard disk with 25msec access or 100MB hard disk with 25msec access or 200MB hard disk with 16msec access, 2MB RAM expandable to 14MB, gas plasma VGA display with 16 gray scales, 1.44MB 3½" diskette drive.

T5200C

18.9 pounds, 20MHz, 80386 with 80387-20 coprocessor socket, 2 internal IBM-compatible expansion slots, 200MB hard disk with 16msec access, 2MB RAM expandable to 14MB, passive matrix VGA full-color screen, 1.44MB 3½" diskette drive.





DESKTOP PC SHOULDN'T BE A DESKTOP PC.

So you get the same power. The same functionality. And the same expandability it takes to keep pace with your company's needs. The big difference is that with a Toshiba Portable Desktop, you can easily turn all that power into increased productivity. All thanks to something no desktop PC could ever hope to offer.

The freedom to take it with you.

To get more information or a free Portable Desktop productivity survey, call 1-800-477-1616.

T3200SX

17.0 pounds, 16MHz 80386SX with 80387SX-16 coprocessor socket, 2 internal IBM-compatible expansion slots, 1 dedicated modem slot, 5 built-in ports, 40MB hard disk with 25msec access or 120MB hard disk with 19msec access, 1MB RAM expandable to 13MB, gas plasma VGA display with 16 gray scales, 1.44MB 3½" diskette drive.



DON'T TAKE OUR WORD FOR IT. GET A SECOND OPINION.



What do other companies know about our Portable Desktop PCs that you don't? If you had a copy of our free productivity survey, you'd know. For example, you'd know that 93 percent of portable users said that they'd never go back to using a conventional desktop. You'd know they've reported substantial increases in productivity. And you'd know why they place so much value on the flexibility and freedom their portables have to offer. Toshiba Portable Desktops. They're no longer a matter of convenience, they're a matter of survival.

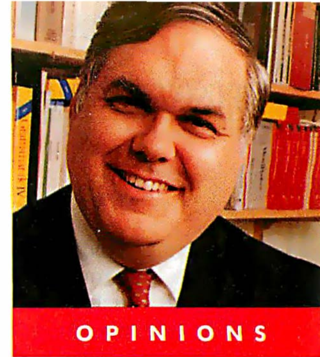
To get more information or a free Portable Desktop productivity survey, call 1-800-477-1616.



In Touch with Tomorrow

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WAYNE RASH JR.

Whose Enterprise Is It?

Welcome to The Business Connection. As some of you know, up until last month my column was called Down to Business, and in it I discussed products and issues as they relate to business. In some ways, The Business Connection is the same, but there's a lot more than the name that's new to this column.

Networking, whether it's local- or wide-area, has become critical to business. More important, business networks can no longer exist as islands of connectivity. Now, if a business is to use its personal computers in ways that make sense from a cost standpoint and help the business competitively, communication throughout the business is necessary. Likewise, if software is to be useful to a business, it must provide good value and exist in the communications environment needed by today's business.

There is more than just networking to The Business Connection. I will discuss business issues as I always have, and I plan to take the time and space required to add my opinions and the opinions of people who have important contributions to make to business computing. Finally, business computing and connectivity are not restricted to the Fortune 500. Small businesses need computers just as much as large businesses do, and sometimes they need them more. I'll look at the needs of small businesses and highlight innovations from smaller businesses that have become more competitive through the use of computers.

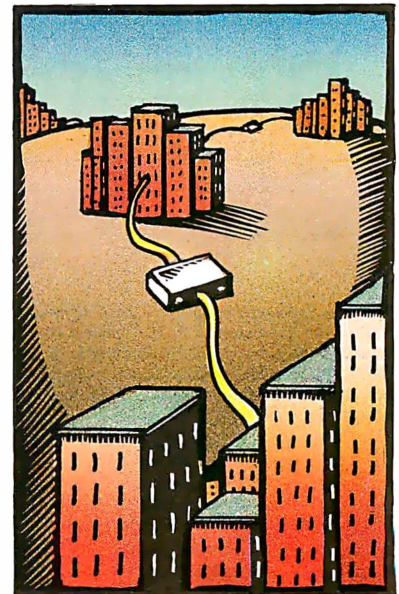
I also want The Business Connection to be your column. During the years I wrote Down to Business, I heard from many readers, and from them I got many good ideas. I also found out about new ways to use computers in business, and I sometimes learned when a seemingly good idea wasn't. I can't tell you how much I appreciate the stories you tell me about the ways in which my column helped you and your business do better, but please know that I do, indeed, appreciate hearing from you.

An Enterprising Solution

I am frequently asked to describe exactly what an enterprise network is and how it can work in a business. There's a great deal of interest in enterprise networking for several reasons, but I'll only mention two of them here. The first reason is that IBM has hit on enterprise networking—and the related enterprise computing—as yet another way to move hardware. It has become, in effect, the latest buzzword for mainframe vendors. At the same time, the term has begun cropping up all over the columns you read in computer magazines. It's not surprising that people wonder what all the fuss is about.

The reason you keep hearing about enterprise networking is because it is one of the best practical ways for businesses to realize the dream of having timely contact with their employees wherever they are. The strength of the desire for this timely contact can hardly be overstated. It is this desire that has given rise to the dramatic growth in fax machines, voice mail, and Federal Express.

Don't be fooled: Enterprise networking can be an easy and natural stage in your company's growth



Enterprise networking delivers immediate contact with others in a business by connecting computer users to a LAN and then connecting the LANs together. For this arrangement to work properly, a large number of the employees need to have access to a networked computer, and they must also have a way to use the interconnected networks to move information. This interconnection can lead to some form of centralized data storage and centralized data management, which is what IBM describes as enterprise computing.

The benefits are obvious, but there is some risk involved. Specifically, you need to be sure that vendors or value-added resellers are addressing your needs and not their own. Knowing what's involved in establishing an enterprise-wide network is your best defense.

Just by the way it's described, an enterprise network sounds big and expensive, and to some extent, that's true, especially if the company isn't already networked. In many cases, though, an enterprise network grows out of existing LANs and existing wide-area networks. This next stage in growth takes place when

companies find that many of their employees are using LANs rather than other methods, such as terminals, to access corporate computing resources. Then the LANs are bridged to the WAN, gateways are installed to mainframes, and, in the process, the company creates an enterprise network.

Gateways and Bridges

Because enterprise networks are made of several LANs connected together, sometimes with a WAN, and because they frequently include access to mainframes or minicomputers, they include devices called *bridges* and *gateways*. While most users are familiar with the terms, there seems to be some confusion as to what the terms actually mean.

Simply put, a bridge is a device for connecting two networks. They need not be the same kind of network. You can, for example, use a bridge to connect two Ethernet LANs or to connect an Ethernet LAN to a Token Ring LAN. You can also use a bridge to connect a LAN to a WAN, perhaps by using an Ethernet-to-T-1 bridge.

A gateway, on the other hand, connects your network to some external service. You might use a Systems Network Architecture (SNA) gateway to give you a pathway from your LAN to your IBM mainframe. You can use an asynchronous gateway to give your LAN a pathway to a modem bank so that LAN users can dial out over telephone lines, or so that remote users can dial in.

While some small LANs don't use bridges, most large LANs and all enterprise networks do. Depending on how your LAN is designed, you may find bridges between small LANs and a central cable traveling through an office building, or you might find a bridge between a LAN in one building and another in a building down the street. The exact details depend on your individual installation.

Here's an example of what an enterprise network might look like: Assume that your company is based in a large headquarters building, with another site located some miles away. The remote site is fairly small and has only a single LAN. Your headquarters building has 12 floors, with an Ethernet backbone cable running through the wiring risers from top to bottom. On each floor, you have a LAN for the use of the people on that floor. Some LANs are Ethernet, and some are Token Ring. An IBM mainframe sits in the basement, and the communications controller has a Token Ring interface.

For this example, I'll assume that you're running Novell NetWare 3.1, since between 60 percent and 70 percent of all LANs run Novell NetWare of some type. The first thing that you would do is attach the LANs on each floor to the building's Ethernet backbone. You can do this in several ways, but one easy way is to use Novell's Bridge software, which comes with NetWare. You create the bridge from a PC clone with either a pair of Ethernet cards or an Ethernet and a Token Ring card, and the Novell Bridge software.

To create a bridge, you install both network interface cards into the PC that you're planning to use as the bridge platform and then load the software. You will have had to generate the bridge software earlier when you were generating the server and workstation software.

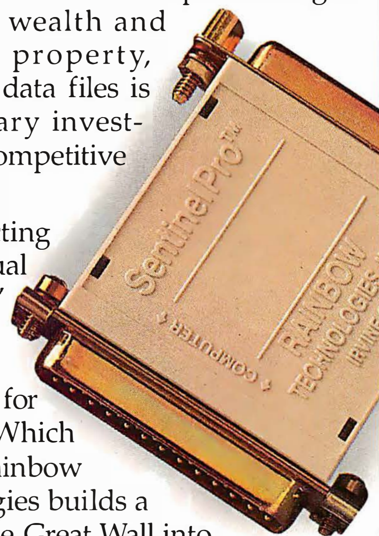
You connect one Ethernet card or the Token Ring card to the LAN on the floor and the remaining Ethernet card to the



Whether you're protecting frontiers and temples in Manchuria, or software and data on the PC or Mac, the Great Wall is a lesson Rainbow Technologies has learned very well.

Software developers must deal daily with the consequences of unauthorized copies and millions of dollars in lost revenue. At the same time, both individual and corporate users must be able to make and distribute copies within legal guidelines.

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Slough, Berkshire SL3 8QY, TEL: 0753-41512 • FAX: 0753-43610

backbone cable. The exact manner of attachment depends on the type of cable you're using, but most likely you'll use either a T connector or a transceiver connection—probably the latter. You connect the other Ethernet or Token Ring card to the LAN just as you would connect a workstation.

If you do this with each LAN in the building, you'll be able to send information between LANs and use file server and other resources on the other floors. When you run Novell's SLIST utility, you'll see a list of all the servers in the building.

Setting up a connection between the remote site and the headquarters is harder, but only because you have to deal with the telephone company. You start this process by ordering either a data line or a T-1 line from your local telephone company. Eventually, the company will install it. This can take anywhere from a few days to weeks, depending. (Depending on what, I'm not sure.)

Once the line is in, you can use a special type of bridge, such as Microcom's MLB/6000, to connect the line to the LAN. You need to have one of these on each end, and, when installed, the bridge makes the LANs appear as if they were directly connected. The Microcom LAN Bridge also mounts in a PC chassis, although, unlike the Novell bridge, it must have a 286 processor and an AT-compatible 16-bit bus. To make the bridge work, you load the bridge software.

That's all there is to the bridges that are required to create an enterprise network. Once they are in place, you can use the LAN just as if the intervening distance had disappeared. While a T-1 line gives the best performance, you can do with a lot less. Microcom, for example, makes bridges that function with standard 9600-bps dial-up lines.

Entering the Big Iron

Now that you've got the networks hooked together, it's time to look at the mainframe. Because this is an IBM mainframe with a controller that uses Token Ring, you will have to bridge to Token Ring to have access to it. More important, you'll have to use 4-megabit-per-second Token Ring rather than the faster 16-Mbps version that PCs use, because mainframe controllers are still stuck at the slower speed.

Once you've done this, which is in no way different from what I have described above, you're ready to add the gateway. Again, I'll assume that you are using a Novell product.

To have communications with the IBM mainframe, you'll need an SNA gateway. This gateway uses IBM's Systems Network Architecture, which is what IBM mainframes understand. Like the bridges, the Novell SNA Gateway runs on a PC clone, but it requires only software, and it's just connected to the Token Ring. The gateway translates Novell's IPX into packets that work in the SNA environment.

Again, that's all there is to it. You load the software for the Novell SNA Gateway into the computer that's supporting the SNA gateway card, and it's running. Of course, you still have to find a way to have your ASCII-based PC work with the EBCDIC on the mainframe and get it to understand 3270 terminal codes, but you can also purchase a 3270 terminal emulator from Novell that will take care of this.

There are problems. The Novell SNA Gateway is limited in the number of sessions it can support (you get up to 128

d Truth Comes Out.

Software Digest® **RATINGS REPORT**®
The Independent Comparative Ratings Report for Selecting IBM PC Business Software

Volume 7, Number 13

MULTIUSER DATABASE PROGRAMS

Ratings Key: ■ green 7.0–10.0 ■ yellow 5.0–6.9 ■ red under 5.0

Software Digest Rating	Overall Evaluation	Overall Power	Program Name	Version Tested	Performance	Versatility	Error Handling	Ease of Learning	Ease of Use	Memory Requirement	Price	Volume Purchase Agreements	Page
★★★	7.0	6.7	dBase IV	1.1	■ green	■ yellow	■ yellow	■ green	■ green	450KB	$795	✓	28
★★	6.8	5.1	Paradox	3.5	■ red	■ yellow	■ green	■ green	■ green	640KB	$995	✓	32
★★	6.8	7.1	FoxPro/LAN	1.02	■ green	■ red	■ yellow	■ yellow	■ yellow	512KB	$1,095	✓	30
★★	6.4	5.1	DataEase	4.2	■ yellow	■ red	■ yellow	■ green	■ green	640KB	$750	✓	26
★	5.8	3.6	R:Base	3.0	■ red	■ yellow	■ yellow	■ green	■ green	520KB	$995	✓	34
★	5.7	6.0	Clarion Professional Developer	2.1	■ green	■ red	■ yellow	■ yellow	■ yellow	512KB	$845	✓	24
★	5.7	6.6	Advanced Revelation	2.01	■ yellow	■ yellow	■ red	■ yellow	■ yellow	640KB	$995	✓	22

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The new dBASE IV® version 1.1 has been rated the #1 Multiuser Database by Software Digest Ratings Report (Volume 7 Number 3, October, 1990).

Because Software Digest accepts no advertising whatsoever, subscribers pay hundreds of dollars a year to receive their reviews—which are considered highly unbiased and objective.

In summation, their 75-page report says: "Among the top ranking programs, dBASE IV (version 1.1) is the most well rounded, with solid performance, versatility, and usability." Commenting on speed, Software Digest points out that "dBASE IV produces all three test reports as fast as or faster than FoxPro/LAN." As for Ease of Use/Ease of Learning, dBASE IV scored as many times in the Excellent range as any other database product tested.

Of course, Software Digest is definitely not alone in its conclusions.

Because consumers have already made dBASE IV version 1.1 the #1 best-selling PC database in the world.

Call 1-800-437-4329 ext. 1407 for more information. Better yet, call 1-800-2ASHTON now to upgrade.

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ITEMS DISCUSSED

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Token Ring $5499
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500 River Ridge Dr.
Norwood, MA 02062
(800) 822-8224
(617) 551-1000
fax: (617) 551-1006
Circle 1220 on Inquiry Card.

NetWare
Access Server 1.01 .... $1995
NetWare SNA Gateway 1.3 .... $2995
NetWare 386 3.1 .... $7995
3270 LAN Workstation 1.1 ... $995
WNIM+ $895
Novell, Inc.
122 East 1700 South
Provo, UT 84606
(800) 453-1267
(801) 379-5900
Circle 1221 on Inquiry Card.

sessions from up to 97 users), so you may require more than one. Also, there has been a persistent problem with Novell SNA Gateways crashing when accessed by workstations that are running Microsoft Windows 3.0. That problem may be fixed by the time you read this.

Dial-in connections from remote computers are handled by the asynchronous gateway. An excellent example of asynchronous-gateway software is the NetWare Access Server. This is a software package that works with the Novell WNIM+ boards to support up to 15 user connections.

The software was developed by Quarterdeck Office Systems and uses the Desqview kernel to support multitasking. The Access Server must run on a 386-based PC clone in order to support the multitasking, and it requires 4 megabytes of memory, plus an additional megabyte of memory for each remote-user session.

Is That All There Is?

In a way, it seems like an anticlimax. Enterprise networking is a buzzword that has been wielded like a Highlander's claymore in the hands of those who'd like to make it seem harder than it is. In many cases, those are people who have a lot to gain by taking control of your network and your company's data systems. Depending on who you are, those who would try to discourage you from trying enterprise networking (or enterprise computing) without them may be your own MIS shop or the manufacturer of your mainframes.

This is not to say that enterprise networking is a simple process, because it's not. It's just that you don't need to be a high priest to make it work. Frequently, some help from a good LAN installer will be all you need. Sometimes you might need the services of a good communications consultant, but these people are working for you, implementing your design.

You don't have to enter the regimented world of enterprise computing as defined by somebody who sells computers. You just need to decide what your company really needs to accomplish and then ask your LAN installer to help you accomplish it.

The result is worth it. Where once your business was connected only by the vagaries of the postal service and the ethereal nature of telephone calls, now you can have your company's data systems forged into a single structure that can support your business.

You have to remember, though, that ultimately this is your business, and the attempts by others to control it for you may be designed more to their ends than yours, because their goal is the selling of computer hardware, not the success of your enterprise.

Down the Road

In future columns, I'll be talking more about ways to communicate with your network, or to have your network communicate with you. As I mentioned before, this and subsequent columns will cover a wider variety of hardware and software than I've included before. This means that you will get a better look at ways to use your computer system, large or small, networked or not.

For those of you who have products or ideas that you think I should consider for this column, please let me know. Write to me care of BYTE. ■

Wayne Rash Jr. is a contributing editor for BYTE and technical director of the Network Integration Group of American Management Systems, Inc. (Arlington, VA). He consults with the federal government on microcomputers and communications. You can contact him on BIX as "waynerash," or in the to.wayne conference.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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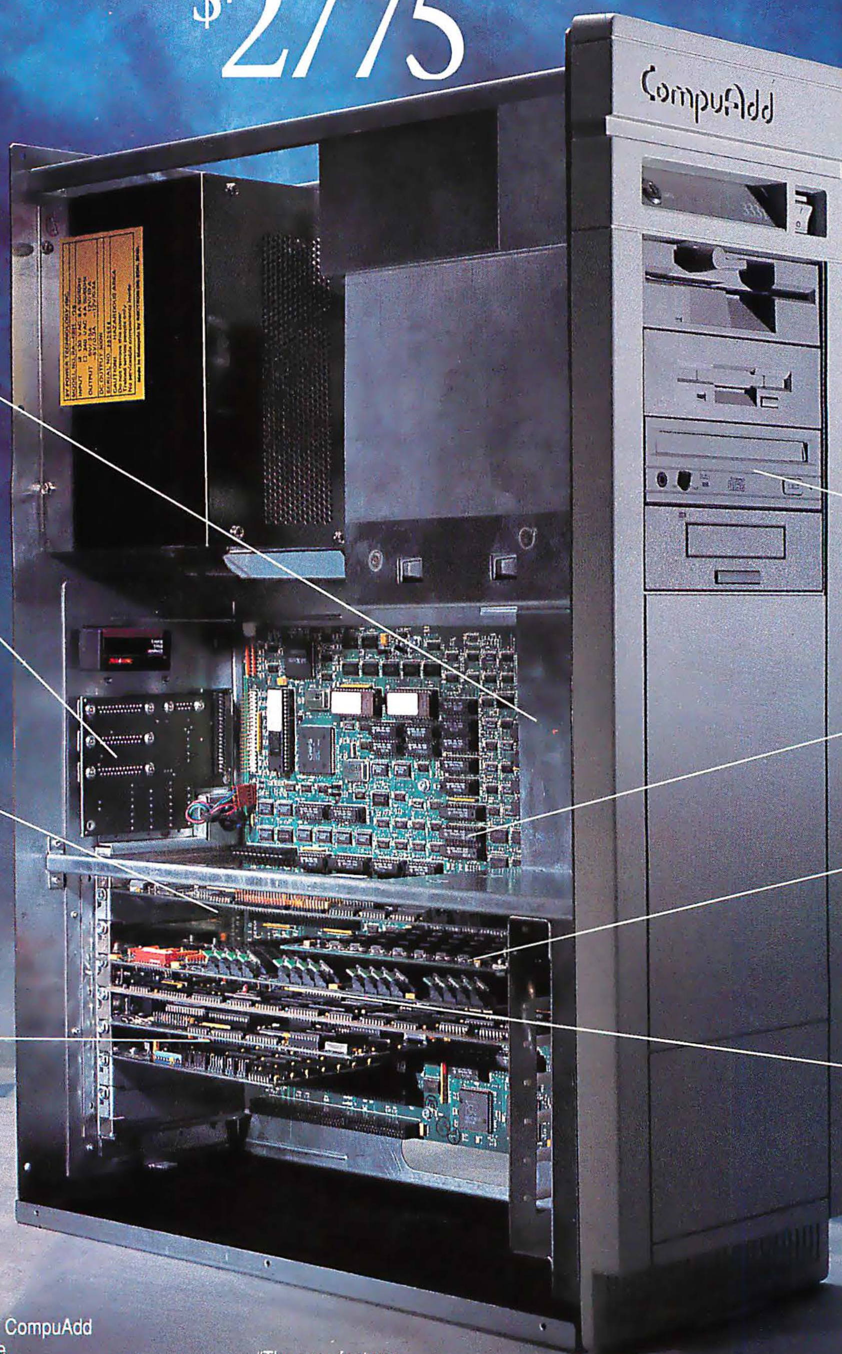
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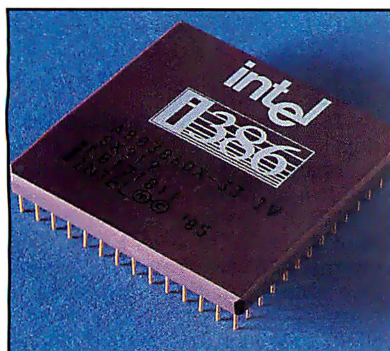
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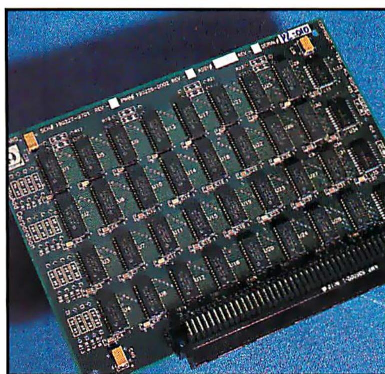
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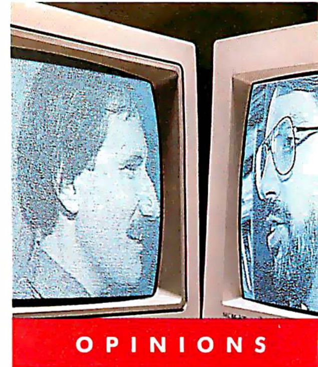
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ROUNDTABLE



OPINIONS

BYTE columnists, staff, and contributors debate the issues

WHY DOESN'T SOFTWARE WORK?

Welcome to Roundtable—a forum in which, each month, BYTE editors, columnists, and contributors debate key issues that affect how you purchase and use hardware and software. The "conversations" take place on BIX. This inaugural installment, inspired by Brett Glass's December 1990 Stop Bit, discusses the problems of making today's sophisticated software work properly with today's sophisticated hardware.

KEN SHELDON: The question Brett Glass posed in December on why software doesn't work just keeps coming back. For example, I tried to install Windows 3.0 on my 386 clone. But due to some weirdness in the system, I can't use the multitasking features. What I mostly need is the task-switching ability. But guess what? I can't use any of my 4 megabytes of memory beyond 640K bytes!

So I try Desqview 386. Now, granted, I haven't devoted more than a couple of hours to this, but so far I've found a half-dozen interesting ways to lock my machine up tighter than a drum while trying to run two or three applications at once. If a BYTE editor has these problems, what's the average user supposed to do?

DON CRABB: This kind of problem is completely foreign to the Mac environment. The Finder and the MultiFinder will run properly on nearly every Mac.

MICHAEL NADEAU: Then why is it that nearly every new Mac box seems to be incompatible with some types of software that ran fine on earlier Macs?

CRABB: A bit of folklore I hear all the time and have yet to validate. Sure, I'll find one or two packages that violated the Apple standards and blow up on a new Mac, but those are rare. Even on highly modified iron, like an accelerated IIfx with 32 MB of RAM and a million INITs, I have almost no software compatibility problems. I have games from six years ago that still run fine on that IIfx.

The question is not whether the software runs as advertised, but whether it runs at all. Ken can't make the basic function of his PC's alternative operating systems (Windows or Desqview) work properly on his PC. I've *never* had such a problem with any version of the Mac System I've ever installed. That, to me, defines operating-system stability.

JERRY POURNELLE: Then you're a bloody genius. Even as I write this, my wife is trying to edit for publication the L.A. Opera newsletter. The Mac II keeps blowing up. It's only a Microsoft Works file. But it's a myth that these machines are easy to use and intuitive.

CRABB: You could write the same complaints about a Toshiba 5200/100 that my wife was trying to use PageMaker for Windows 3.0 on. It kept blowing up. Does this mean that the Toshiba is a bad machine or hard to use? No. It means that Toshiba hasn't had the hot PR that Apple has about intuitiveness and ease of use. The Mac Myth is just that. I can't think of a single bit of Mac/Apple PR hucksterism that ought to be believed, but that doesn't make the Mac any less of a machine.

Nor does it make it less intuitive or easy to use in some situations and a royal pain in other circumstances. Just like that Toshiba running Windows and PageMaker.

TOM THOMPSON: It's behavior like this in Microsoft products that starts the rumors of software not working on the Mac. WingZ 1.00 doesn't work on the IIsi, but you get an alert box stating that there isn't an FPU on the system, and WingZ gracefully returns you to the Finder. Microsoft Excel doesn't; it just glibly executes

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an FPU instruction and blows you into a bomb box. I could accept this from a shareware product, but from a vendor like Microsoft, it's inexcusable.

A well-documented trap provides pertinent information (e.g., CPU type, color, FPU, and processing speed of a Mac) that an application can query when you launch it. Good software on any platform should try to determine what resources it has to work with, and if it lacks a critical one, it should explain why it can't run (in English) and bow out politely.

LARRY LOEB: Apple's philosophy of "write to the manager and we'll do the glue" seems sensible and has made my software investments work throughout several hardware revisions. And the IIfx is a major hardware revision.

> **To many companies, quality control is a cost center.**

NADEAU: OK, I'll accept that the stability of the Mac operating system causes far fewer problems. So let's get back to the original question: Why can't software always work as it's supposed to?

WAYNE RASH JR.: In many cases, the problem has to do with considerations outside the realm of software engineering. To many companies, quality control is a cost center; there is only enough time and money to do the minimum necessary to get the software out the door. There is tremendous competitive pressure to get complex software into the marketplace at the earliest possible time. Couple this with the marketing pressure to announce software as early as possible, and you have a dangerous combination.

The development side finds itself required to develop increasingly complex software for a rapidly expanding universe of target platforms, while finding its development cycle limits imposed (probably unrealistically) by marketing. As it's also being squeezed on the other end by the requirement to minimize costs, it's a wonder that most software works as well as it does.

You more often see good quality control on products from privately held companies, where the need to avoid a takeover or keep the stockholders happy doesn't exist. A good example is WordPerfect Corp. While many complain that they don't like the WordPerfect approach to word processing, it's a top seller because it works as it's supposed to work. The company is willing to spend the time and money on development and service, and to publish updates and make them available at a nominal cost.

CRABB: The processes of software design and marketing have little in common. Thus, many software functionality decisions get made by the product manager, who is often a marketer with no design experience. That leaves the programming manager to try to implement designs that look good in brochures, press releases, and ads, but are nearly impossible to code.

POURNELLE: In many cases, the software works fine, but the installation programs have not been looked at by anyone who understands the software. Installation programs are tacked on as an afterthought, and they insist that you do the installation *their* way.

OWEN LINDERHOLM: Installing software is getting harder. It used to be that all software was hard to install; then things got easier, with most software implementing semi-intelligent installation programs actually called "install." Now, people are getting clever again, using different names or requiring you to run the installation program from somewhere strange.

An example is Windows programs. The only truly easy-to-install programs are the separate new saver modules for the shareware ScreenPeace screen saver. New modules are installed by copying them to your Windows directory. Next time you start Windows and ScreenPeace, it finds the new saver module and installs it. Most other Windows programs require you to run Windows, run an installation program on drive A, go through some rigmarole, and then reboot afterward. Some even need to be installed from *outside* Windows!

RASH: It's clear that installation programs frequently are a joke, that compatible programs frequently aren't, and that a lot of the bugs go unfixed. Why? I

think part of the problem is that we aren't raising a hue and cry loudly enough. I think we also aren't trying the PC software (or maybe even the Mac stuff) on a wide-enough variety of machines. I'm not sure we always can, simply because many of us have resource limitations that prevent us from having access to more than a small number of machines.

But this doesn't absolve the manufacturers of responsibility to see that their software works as advertised. It's ridiculous that computers from major vendors can't run some software from major manufacturers. Many vendors claim that their software is only for "IBM and 100 percent compatible computers," but what does that mean? Even IBM isn't 100 percent compatible with itself. I think that the software manufacturers are intentionally cutting back on development and testing because the customers aren't holding their feet to the fire. We can help do that, and we should.

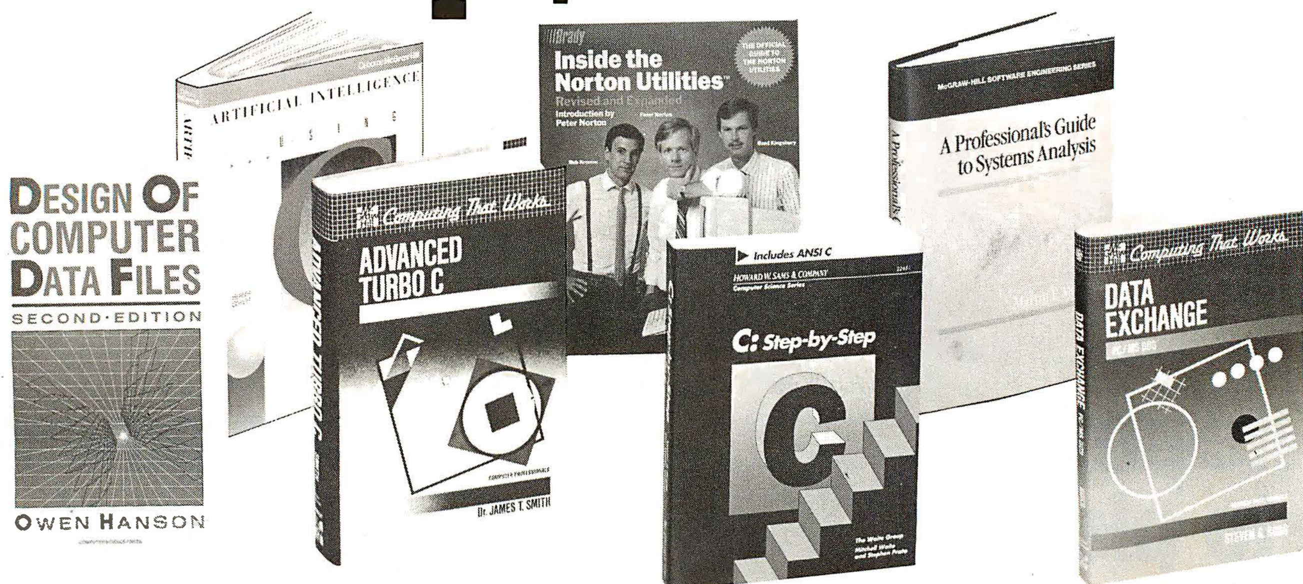
POURNELLE: I do try stuff on a variety of machines, as well as on the network, and I find more broken software than most. I often find the installation programs to have been written by imbeciles as an afterthought. They could simply tell you to copy everything and then run the program; but no, most want to do complex installations (that serve the copy-protection function more than anything else). I think few people use their own software.

But in fact, one reason they get away with it is that we don't spend enough time yelling at them. Even I've got away from doing that; I will do better in future.

RASH: One of the most irritating features of installation programs is that many seem much more finicky about what machine they are used on than is the software they support. I've seen several that simply will not work with DOS 4.01, for example, and a few that will not work with large disks. The software, once you get it installed, will work fine in those conditions, but you have to figure out how to install it on your own. I think much of this kind of problem is a combination of a lack of desire for excellence and an effort to get the stuff out the door. Neither is an acceptable excuse.

I think these companies give only the briefest thought to the installation programs. I guess they think that, since it will only be used once, it doesn't matter. But the reality is that it's the first impression their customers have of their commitment to quality, and we all know how important first impressions are. ■

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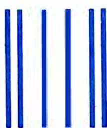
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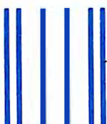
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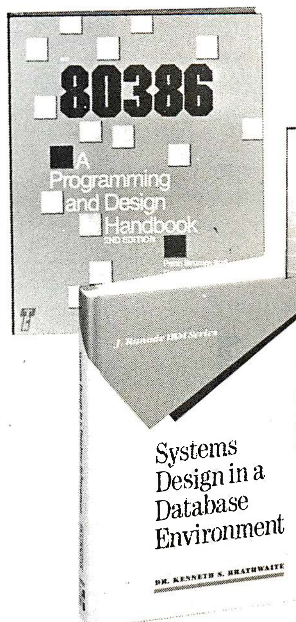
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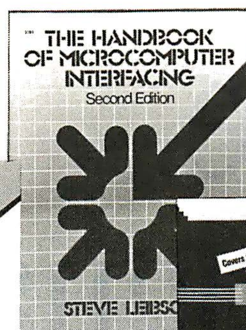
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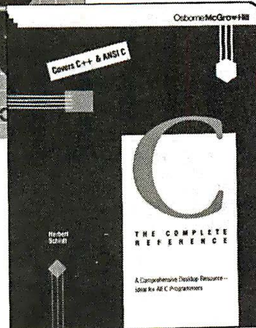
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FEATURE

The Multilingual Edge

Machine translation of human languages makes sense if you deal with large volumes of documents written in other languages

PETER M. BENTON

In the past few years, the world has shrunk into a village, and age-old barriers to communication have fallen. The Iron Curtain has been dismantled, Germany unified, the channel connecting England and France built, and the European Economic Community born.

Glasnost, or openness, the watchword of the new Soviet order, is founded on improved communication—person to person, person to institution, business to business. With rapidly accelerating globalization, the economic necessity for people to do business in dozens of languages has spurred the demand for fast, accurate, and easy-to-use translation systems.

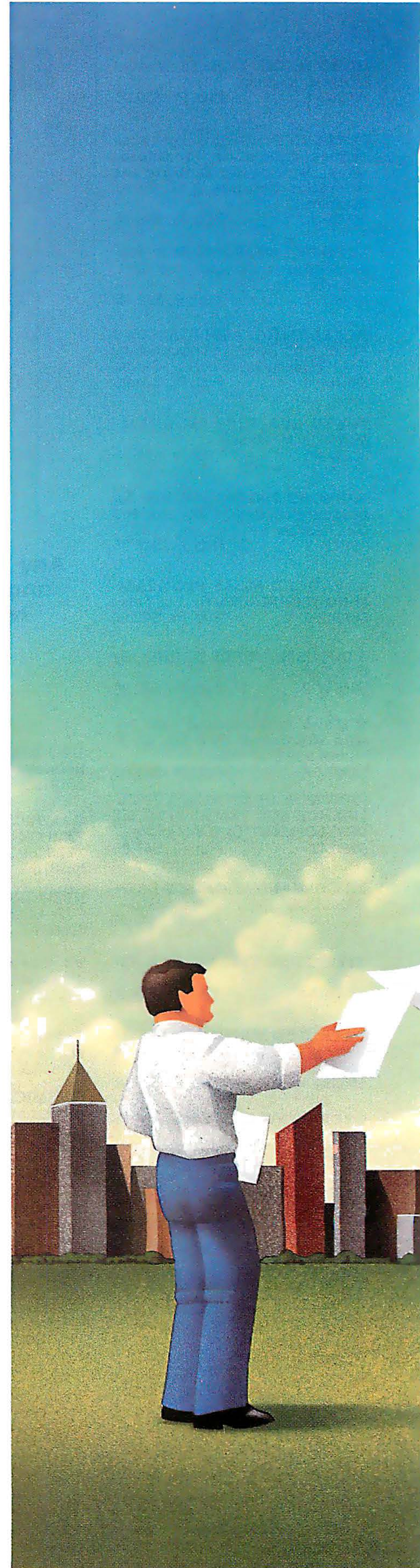
To conduct business globally, all types of documents must travel across the boundaries of countries. Many of these are good candidates for machine translation.

Language translation, natural or automated, meets two complementary needs: telling others what you have to offer (information dissemination) and keeping track of the outside world (information acquisition). Although for the foreseeable future people will still play an essential role in translation, machine translation has the potential to improve productivity and consistency dramatically.

A sampling of some business-oriented information dissemination includes sales and advertising literature, product operations instructions and service procedure data, and technical and academic literature. Many dissemination applications also have an information acquisition side—for example, daily correspondence; economic, commercial, and military news; and business and personal conversation.

Information dissemination and acquisition require different capabilities from a translation system. Dissemination, which is the more common application, requires smooth interaction with a publishing system. Acquisition, such as tracking technical advances and news, requires the ability to communicate with a variety of input devices. Because computers and other appliances have become more and more our partners, it has become vital that they communicate with us in our own natural languages.

Most of the commercial-grade automated translation systems started out on mainframes. But they are now, or soon will be, available or accessible from workstations such as the Sun SPARC workstation and server, as well as from many 386 and 486 platforms (see the photo). Workstation availability makes it



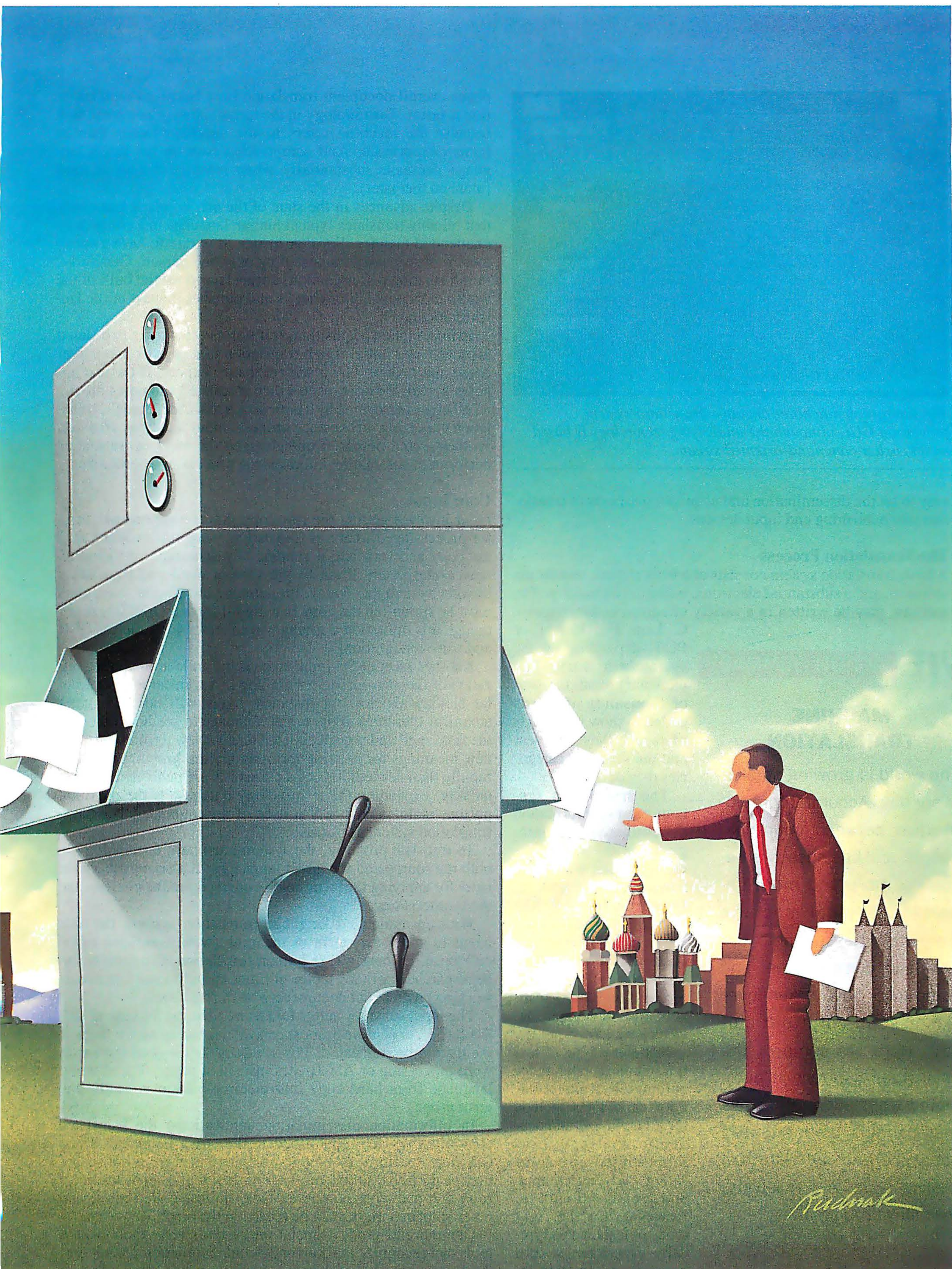
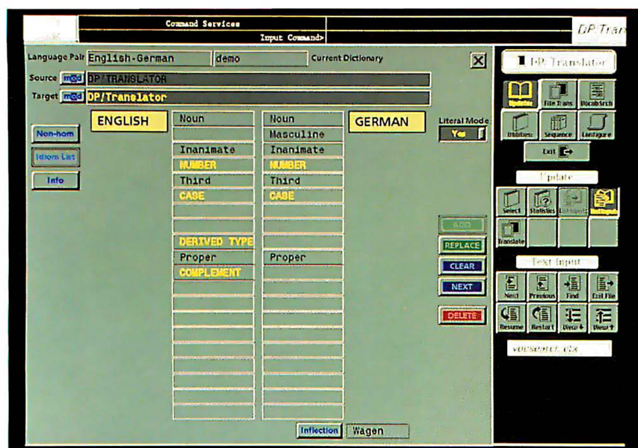


ILLUSTRATION: THEO RUDNAK © 1991



The Intergraph machine-language Translator system provides a GUI, although the underlying technology is based on an earlier command-oriented system.

easy to tie the dissemination and acquisition aspects of translation into publishing and input devices.

The Translation Process

A basic translation system consists of a workstation, translation software, and a substantial electronic bilingual dictionary. The software may be written in a variety of computer languages—C, Lisp, FORTRAN, or PL/I—depending on the system's history. The dictionary contains tens of thousands of words coded to show what parts of speech they represent and the semantic categories they occupy.

The translation systems used in information dissemination are integrated with or can exchange files with publishing systems such as those from Interleaf. The translation systems that are used for information acquisition are integrated with optical character recognition (OCR) scanners and other input devices.

Not every type of text is a suitable candidate for automated translation. Poor candidates include turgid technical and academic writing, transcripts of spoken conversation, advertisements, and creative literature. However, for the right types of texts, users typically experience several benefits. Automation reduces overall document translation time because raw translation is faster. Terminology in the target copy is more consistent because the machine refers to the database rather than to human experience. And composition costs in the target language decrease substantially when markup coding is used (more on that later).

BYTE ACTION SUMMARY

MACHINE TRANSLATION

The world is growing smaller every day. Accurate communication between countries, people, and businesses is becoming more and more important. Manual machine translation has become too slow and cumbersome, and computers have taken over this essential but difficult task. Here are some of the challenges inherent in automated translation, and ways that today's sophisticated hardware and software are dealing with, and resolving, the many problems.

Despite advances in the state of the art, no black box exists that reliably translates typical human language in a completely unattended manner. For that matter, it is rare to have a document professionally translated by only one person. Generally, in information dissemination, a translator does the bulk of the work, and a post-editor checks and polishes the text of the finished document.

In information acquisition, translators often use a two-tiered approach. An initial rough translation of a page or two is prepared and reviewed by a subject matter expert. If the text appears useful, the document is then translated and post-edited.

Whether performed by a person or a machine, though, translation undergoes a five-stage process: input, analysis, transfer, synthesis, and output. Depending on the kind of translation performed, automation improves the process in several areas.

Uno: Input

Input involves getting the raw copy into the appropriate form for processing. In natural translation, human translators read the copy and translate it sentence by sentence, and simultaneous interpreters listen to the spoken word and translate it thought by thought. Today, for machine translation, computers must be spoon-fed the copy in a digital form as ASCII text (although this limitation is giving way to technology such as OCR and voice recognition).

Another facet of the input stage is the collection and organization of the appropriate terminology. A translator of molecular biology articles, for instance, likely will need to gather technical literature in the target language to see how others in the field spell and use specialized terms. New terminology and new meanings for existing terminology are growing far more rapidly than new editions of dictionaries are published. Consequently, expanding the terminology database is the most important maintenance task a user of an automated language-translation system performs.

To translate properly, the system must have terminology in both the source and the target languages. It also must have the rules for applying the terminology correctly in the analysis and the synthesis stages.

With an automated language translation system, the user needs to add a new term or meaning (with associated rules) only once. By contrast, in human translation, that term has to be researched perhaps scores of times by individual translators working on different documents at different times.

The input stage for automated translation can be easy or difficult (i.e., expensive or inexpensive) depending on the form of the data to be translated. For accuracy, it's best to start with word processing or ASCII files instead of paper. Transferring language from hard copy into electronic form is costly and error prone.

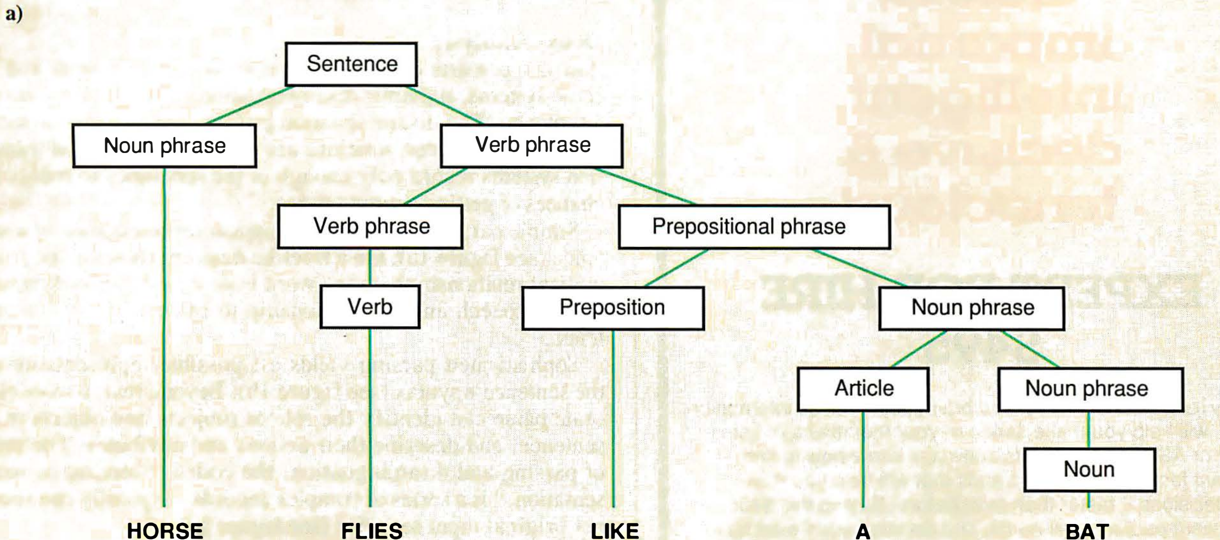
In information dissemination applications, the translated copy often will be republished in the target language. Thus, carrying structural or typographic attributes from the source may be desirable so that markers for heads and subheads, table rows and columns, numbered lists, italics, underscores, and other emphasis marks can be reused in the target language.

Commercial-grade translation systems have table-driven tools that recognize markup codes and record their positions in the linear text so that they can be regenerated after transfer.

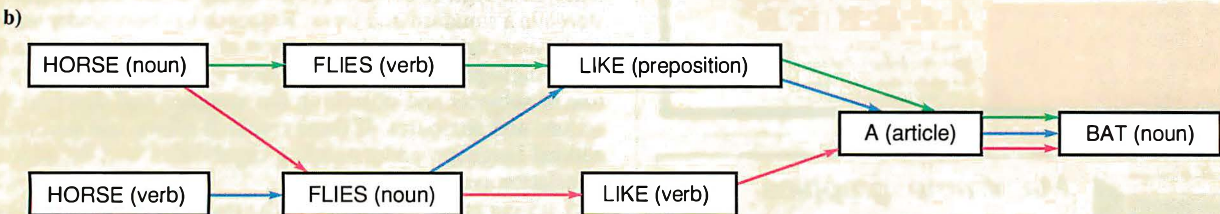
continued

PARSING AND INTERLINGUA REPRESENTATION

a)



b)



c) (**Syntactic reading**)

Document: 44215
Sentence: 52
Subject: ((**FLY** (syntax: headnoun, plural)(semantics: neuter, animate, blood-sucking insect))
(**HORSE** (syntax: noun, modifier)(semantics: inherit headnoun)
(flag: ill-formed compound noun, should be one word))
)
Verb: ((**TO LIKE** (syntax: verb, present)(semantics: preference))
)
Object: ((**BAT** (syntax : headnoun, singular)(semantics: neuter, animate, mammal))
(**A** (syntax: indefinite article, singular))
)

Possible syntactic readings (parentheses added to clarify)

- (The **HORSE** (runs so swiftly, he) **FLIES LIKE A BAT.**
- **HORSE FLIES** (insects) **LIKE** (to feed on) **A BAT.**
- **HORSE** (around, you) **FLIES LIKE A BAT.**

Simple parsing **(a)** *yields a single parse tree even if the sentence is ambiguous (i.e., it can be parsed several ways). At this stage, the parsing is purely syntactic. Sophisticated parsing* **(b)** *yields a parse forest composed of all parses that the grammar allows. Syntactically, the sentence in this example can be interpreted several ways. Semantic analysis of the parse forest will yield a most likely interpretation (syntactic reading #2), which becomes the interlingua representation. An interlingua representation* **(c)** *details the syntax of a sentence and includes enough semantics to increase the likelihood of creating an accurate synthesis. Elements of the representation are actually coded as numbers that are indexes to multilingual dictionary entries and phrase structure templates.*

Special rules are needed to handle phrases, because the word order may change or the phrase may be broken up entirely in the translation process (see below).

Deux: Analysis

Analysis consists of parsing (simple or sophisticated) and, in some systems, semantic disambiguation to clarify the syntax of a sentence. The disambiguation process decides what is meant when multiple interpretations are possible. Automated translation systems record only enough of the semantics to reduce the chances of getting a wrong parse.

Simple parsing yields a grammatical representation of a sentence (see figure 1a). On a treelike diagram showing the grammatical relationships, every word is positioned according to its part of speech and its relationship to other words in the sentence.

Sophisticated parsing yields all possible representations of the sentence's syntax (see figure 1b). Beyond that, a more elaborate parse can identify the role of subjects and objects in the sentence, and describe their actions and attributes. The result of parsing and disambiguation, the coded "interlingua representation," is a series of complex records—typically one record per original input sentence (see figure 1c).

You can think of the interlingua as the essence of the sentence in a logical structure. Attributes of the interlingua are stored in a standardized form. Research has been under way for many years now on the development of systems that possess natural language understanding. Such systems can identify the role of subjects and objects in the sentence and describe their actions and attributes. If these research efforts are successful, natural language understanding capabilities will be added to translation systems.

A system intended to work with many languages must have a rich interlingua representation so that it can record all the classes of distinctions used in any of the languages. A great deal of variation exists in the data structures that different translation systems use. Each data structure reflects the linguistic expertise of the system's architect, as well as the intended use of the system. For instance, the Distributed Language Translation system being developed in the Netherlands (see the text box "Translation Technology Alternatives" at right) uses Esperanto as its interlingua. The Esperanto language was invented in the late 1800s for scientific discourse.

Drei: Transfer

During the *transfer* process, systematic changes are made to the interlingua representation so that it can be used to generate copy. In essence, the transfer process moves markers for all linguistic characteristics to the new positions needed for the next stage, synthesis.

In human beings, the transfer process is automatic and hidden from view. But in computers, the interlingua representation is highly formalized and does not resemble linear copy. The system needs one transfer algorithm for every target language. Transfer algorithms are tightly integrated with the interlingua and play an important role in handling complex sentences accurately.

The system performs many operations during the transfer process, among them the conversion of the treelike representation into a linear series of tokens (e.g., verbs, nouns, pronouns, and adjectives). The token sequence reflects the appropriate ordering of sentence parts (e.g., subject, verb, and object) in the target language; for example, verbs appear in different characteristic positions depending on the language.

Selection of the appropriate substructures for clauses and

Translation Technology Alternatives

Translation of human language has been a goal of computer science from the very beginning of the field. In 1966, the infamous ALPAC (Automated Language Processing Advisory Committee) report, prepared by the National Academy of Sciences, concluded that automated translation was unattainable in the near future. The report recommended that government funding be redirected to basic cognitive science research, a suggestion that squelched U.S. research in automated translation for more than a decade. During that time, however, research continued in Europe and Japan.

In 1989, a 10-year study, supported by the Japanese Ministry of International Trade and Industry (MITI), found that virtually all of the circumstances underlying the ALPAC conclusions had reversed. This study concluded that machine translation is both practical and necessary for specific information search needs (information acquisition) and cost-effective production of certain classes of documents (information dissemination).

Early translation systems performed a word-for-word replacement of target language for source language. Such systems ignored the fact that sentence structure varies widely and that words play more than one role (e.g., noun or verb) and have more than one meaning. The lowest-cost translation systems available today on personal computers still suffer from these limitations. If you decide to play around with one, make sure there is a money-back guarantee.

To keep track of Russian technology during the Cold War, the U.S. Air Force funded development of a translation system by IBM called the Mark II, which performed word-for-word replacement. In 1970, the Mark II was replaced by a program called Systran, which had become operational in 1964. Systran, now owned by Systran Translation Systems, consists of low-level primitives to manipulate human language. Instead of performing word-for-word replacement, the Systran system translates through analysis of the sentence's syntax.

Systran is considering porting its translation program to workstations, but currently you can access it (for a price) via modem. Since 1981, Systran has been developing Japanese-to-English and English-to-Japanese modules. The company offers more than 20 language pairs.

The Pan American Health Organization (PAHO) has developed two translation systems, Spanam and Engspan. Today, these systems are used on a production basis, and they collectively have translated millions of words. PAHO has organized a consortium of public-sector supporters to fund porting of the PAHO system to workstations and to develop additional language pairs.

Logos was originally developed to translate U.S. Air Force equipment manuals into Vietnamese. Today, Logos runs on various classes of computers, including several IBM models and Wang departmental computers, and offers close to a dozen language pairs. Logos uses an internal representation that includes both syntax and semantics in the same data structure. Written in FORTRAN, Logos can be ported to workstations.

Originally developed on DEC VAXes, the Smart line of translation systems now is offered for Sun SPARC workstations and SCO Xenix on 386 and 486 workstations. Smart smoothly interfaces with a number of publishing systems, including Interleaf, FrameMaker, PageMaker, Microsoft Word, and WordPerfect.

In the early 1960s, the University of Texas started development of Metal, a linguistically sophisticated system for German-to-English translation. The result was a huge FORTRAN program that was tremendously resource intensive. In the late 1970s, Metal was rewritten in Lisp, and, in 1980, Siemens acquired the software. In 1989, Siemens introduced Metal as part of an integrated multilingual publishing system that was composed of a Unix workstation and a specialized Lisp-based translation server. Metal preserves markup codes and provides an expert system to help the user update its multilingual dictionary.

Tovna Machines was incorporated in Israel in 1985 to commercialize technology emerging from a research project begun in 1977. Tovna is commercially available for about half a dozen language pairs. Developed on Sun workstations, Tovna is written in C. The Tovna architecture uses a variety of AI methods to both translate and learn new rules by examining how the post-editor polishes the translation. Reportedly, this software has the capacity to create general rules from specific examples, and it gives an expert user the ability to refine the rules over time.

Alpnet offers its Automated Language Processing System software for use on personal computers. Users of ALPS have massive translation contracts with Alpnet and need in-house automation for some portion of the translation task. Alpnet's system provides machine-assisted translation. It works interactively with the translator to provide automated dictionary lookup and sentence-by-sentence translation.

Executive Communication Systems offers a series of toolkits for processing language, at costs ranging from $50,000 to $150,000. Reportedly, users can develop their own customized translation systems and create the necessary lexicons. At the other end of the price range is GTS, by Globalink, possibly the lowest-priced sentence-level translation system available.

BSO Language Translation in the Netherlands has been working since 1982 on prototypes of a Distributed Language Translation system. The company expects commercial versions to be available in 1993. It has ambitious objectives—to be able to translate general business correspondence and technical literature. BSO expects to achieve this goal by equipping DLT with an immense knowledge base and the ability to query the user about the copy. In essence, the system will ask the user to pre-edit copy when it contains ambiguities. Developed on Sun-3 workstations, DLT's software modules are written in C and Quintus Prolog.

In Japan, Fujitsu offers one commercially available translation system, called Atlas G, which uses a syntactic approach. The firm is seeking partners for a second system (still in a multiyear development stage) called the Atlas II. This system will incorporate a massive knowledge base of commonsense information.

phrases also occurs during the transfer process. Acceptable clause and phrase structures differ markedly; for example, Spanish compound-noun clauses tend to include many linking words, while German noun clauses simply string nouns together.

Associating linguistic markers for tense, number, aspect, gender, and so forth with the tokens is another transfer operation. For example, languages that use gender and plurality (e.g., French) reflect these characteristics in nouns, pronouns, prepositions, and verbs. The French word for *the* can be *le*, *la*, or *les* depending on the gender and number of the related noun.

Four: Synthesis

In the *synthesis* stage of machine translation, the ordered sequence of linguistic tokens is converted into language. The result of synthesis is sentences (perhaps with typographic markup) in the target language.

Once again, in humans, the synthesis process is automatic and hidden from view. In computers, however, much of synthesis is simple lookup and replacement, while other parts of the process are more elaborate.

Synthesis of prepositions (e.g., *at, in, on,* and *by*) and pronouns (e.g., *this, that, who, what, I,* and *you*) is straightforward. Strings of tokens can be immediately replaced by words. Synthesis of nouns and verbs, though, often requires intelligent selection among a range of candidates, and the choice depends on the appropriate jargon for that translation subject area.

Many problems can arise during synthesis. Synthesis is especially difficult in fields such as law, where underlying philosophies may vary substantially from country to country. But problems can also occur in other fields. For example, in an automatic translation of a medical text from English to Spanish, the English word *nostril* was translated into a Spanish word equivalent to the English word *vent* instead of the phrase *orificios de la nariz*. Since the lexical database did not contain *orificios de la nariz*, it used a "next best" term, which was suitable for inanimate objects only.

Cinque: Output

Human-performed translation yields written documents (often produced using desktop publishing) or a spoken utterance. In automated translation, however, the user typically has several choices of output, depending on the application for the translation. Some systems provide an editing environment, and others produce files for subsequent editing in a word processor.

Usually, automated translation *output* is formatted as side-by-side reports, single language reports, or word processing files. The user also has the option of seeing error flags.

A side-by-side report or word processing file would show the source copy on one side and the target copy on the other. If present, error flags would be shown on the line where the error was detected. With help from the side-by-side report, the user can check and adjust the translation. Error codes draw the eye to areas needing attention. In production translation operations, the principal users of the side-by-side report or word processing file are post-editors, who polish the translation into final form. Secondary users are terminology experts, who examine what the post-editors have done and adjust the terminology database accordingly.

Special Features

With some automated translation systems, users can choose special features that are useful in particular applications. These features include repetitions processing, microglossaries,

TRANSLATION SYSTEMS, DEVELOPERS, AND VENDORS

Prices on the following systems will vary according to application, the languages translated, and features included. For detailed information on prices, please contact the company.

Automated Language Processing System (ALPS)
Alpnet Corp.
4444 South 700 East, Suite 204
Salt Lake City, UT 84107
(801) 265-3300
fax: (801) 265-3310
Circle 1000 on Inquiry Card.

Distributed Language Translation (DLT)
BSO Language Translation
P.O. Box 8348
NL3503 RH
Utrecht, The Netherlands
31-309-119-11
fax: 31-309-440-48
Circle 1001 on Inquiry Card.

ECS MT Toolkit
Executive Communications Systems, Inc.
455 North University, Suite 202
Provo, UT 84601
(801) 377-1167
fax: (801) 374-6292
Circle 1002 on Inquiry Card.

GTS
Globalink, Inc.
9302 Lee Hwy., Fourth Floor
Fairfax, VA 22031
(800) 255-5660
(703) 273-5600
fax: (703) 273-3866
Circle 1003 on Inquiry Card.

Logos
Logos Corp.
111 Howard Blvd., Suite 214
Mt. Arlington, NJ 07856
(201) 398-8710
fax: (201) 398-6102
Circle 1004 on Inquiry Card.

Metal (available in Europe)
Siemens AG, ZI2, Attn. Dr. Hartmut Runge
Wittelsbacherplatz 2
8000 Munich 2, Germany
49-89-234-3690
fax: 49-89-234-2844
Circle 1005 on Inquiry Card.

Smart Translator
Smart Communications, Inc.
P.O. Box 963, FDR Station
New York, NY 10150
(212) 486-1894
fax: (212) 826-9775
Circle 1006 on Inquiry Card.

Spanam, Engspan
Pan American Health Organization
525 23rd St. NW
Washington, DC 20037
(202) 861-3200, ext. 4338
fax: (202) 223-5971
Circle 1007 on Inquiry Card.

Systran
Systran Translation Systems, Inc.
P.O. Box 907
La Jolla, CA 92037
(619) 459-6700
fax: (619) 459-8487
Circle 1008 on Inquiry Card.

Tovna Machine Translation System (MTS)
Tovna Machines, Ltd., Israel (developer)
Translation Technologies International (Exclusive Distributor in North America and China)
3007 Tilden St. NW, Suite 3L
Washington, DC 20008
(202) 244-8500
fax: (202) 244-8165
Circle 1009 on Inquiry Card.

Translator
Intergraph Corp.
1 Madison Industrial Park
Huntsville, AL 35894
(800) 826-3515
fax: (205) 730-2461
Circle 1010 on Inquiry Card.

and stylistic personalization.

Repetitions processing saves time in translation of product documentation. Documentation for equipment, systems, and software usually changes in only minor ways when new versions of the product come out. Repetitions processing works by keeping a database of all sentences processed by the system and only retranslating new and changed sentences.

Most commercial-grade translation systems have a microglossary feature. The user specifies the subject area the source text comes from, and the microglossary contains equivalent terms that apply to that field. This capability makes it possible to translate text without large knowledge bases.

The next step beyond a microglossary is stylistic personalization. With this feature, the system watches what the post-editor does and infers rules for use in future translations. Stylistic personalization is useful when large volumes of material are being translated for a specific purpose, such as operations instructions or loan contracts.

Pursuing Machine Translation

You should consider implementing machine translation in your company if any of the following applies: your business plan is going global and your products require lots of documentation, the documentation needs to be translated more rapidly and consistently, or you need to track new developments in other countries to stay competitive.

Fortunately, because of the increasing availability of translation systems on personal computers and workstations, you can run a test project and monitor results in a controlled environment. Thus, on a small scale, you can assess whether machine translation can help you meet these needs.

More than with other applications, though, you need to thoroughly test the systems. To test a system you would use the following procedure: (1) Run through the systems the kinds of materials to be translated; (2) give the translations to experienced post-editors; and (3) analyze the overall final results to see if the system meets your particular needs.

Adopting machine translation requires a great deal of learning and dedication. Work flow, job descriptions, and habits must change. The fact that raw translation is now performed by a machine, rather than people, transforms the fundamental nature of the process. ■

Peter M. Benton, formerly McGraw-Hill's chief scientist, evaluated and applied advanced technologies, including automated translation and other natural language processing systems. He now consults on the assessment and introduction of new technologies. He can be reached on BIX as "benton."

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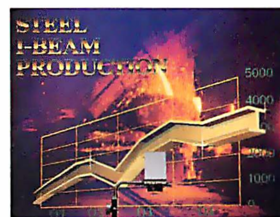
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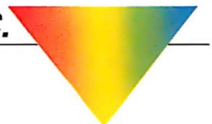
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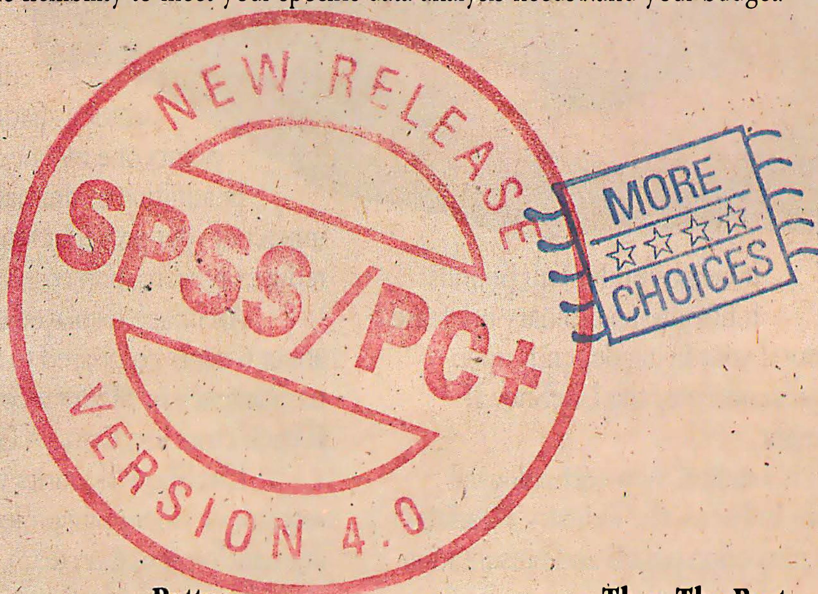
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MODULA'S CHILDREN, PART II

Oberon

A distillation of the best features from Pascal and Modula-2, Oberon is smaller, less complex, and more user-extensible

DICK POUNTAIN

As the triumphal march of C proceeds and language "inertia" becomes heavier by the month, the prospects for introducing a new general-purpose programming language must seem pretty slim. However, one candidate deserves to be taken very seriously: Oberon, Niklaus Wirth's successor to Modula-2.

Professor Wirth, of the Eidgenössische Technische Hochschule (ETH) in Zurich, Switzerland, is creator of Pascal and Modula-2 and must therefore be considered one of the most influential language designers in the short history of the art. Oberon is also noteworthy because, at a time when most software systems seem to be bloating inexorably into middle-aged spread, it is actually much smaller and simpler than its predecessor.

The Oberon language was born in 1988 as *Voyager* was flying past Uranus's moon of the same name. The superb precision of *Voyager*'s navigation inspired Wirth to make this linguistic tribute.

Strictly speaking, Oberon is more than a language. It's a complete operating system and environment for a networked 32-bit workstation called Ceres, just as Modula-2 was the operating environment for the Lilith workstation. Ceres was entirely designed at ETH and is used extensively by the students in Wirth's department. However, in the next few years, you probably will see implementations of the Oberon language under other operating systems, such as MS-DOS.

Oberon's Aims

Wirth developed Oberon out of Modula-2 as a system programming language to implement the software for the Ceres workstation network. His intention with Ceres was to create a simple, reliable, and inexpensive workstation, and achieving this meant determining just what was essential and what was expendable in the hardware realm. This simplifying philosophy soon spilled over into the software as well.

Wirth believes strongly that an operating system should be designed as separately compiled modules with well-defined interfaces, and that writing applications is equivalent to extending the operating system by adding new modules. Because Modula-2 has excellent support for such modularity, it was the first choice for the Ceres project. However, Wirth decided that Modula-2 doesn't have sufficiently powerful facilities for user extension. In particular, it doesn't allow you to define new data types as extensions of older types. Oberon was born from the decision to add type



extensions to Modula. (I'll explain how type extensions work later on.)

Another firm requirement of the Ceres project was that the operating system should have a dynamic central memory allocation scheme, complete with garbage collection. It would have been possible to add a garbage collector to Modula-2, and indeed this has been done in the Modula-3 language developed by DEC and Olivetti (see "Modula-3" in the November 1990 BYTE).

However, Wirth thought that the variant record feature, which Modula-2 inherited from Pascal, would have been an obstacle to secure and efficient garbage collection. Both Pascal and Modula-2 permit the insecure practice of modifying the tag of a variant record independently of the variant field values (or omitting the tag field altogether). Since almost all implementations actually overlay the different variants of a record on the same area of memory, programmers can defeat the strict typing mechanism in this way, making it impossible for the language to efficiently discover the actual size of a variant record at run time. An automatic garbage collector must be able to unambiguously decide the size of objects that it wishes to discard.

Fortunately, Oberon's type-extension mechanism makes variant records completely redundant, as it can achieve the same flexibility in a type-safe way. So variant records were dropped.

Once the pruning knife was unsheathed, other features of Modula-2 started to look vulnerable and were dropped, because they were either redundant or not worth the complication they introduced into compilers. As a result, an Oberon compiler can be much smaller than a Modula-2 compiler; the Oberon implementation of July 1988 involved just 130K bytes of source code, yielding 39K bytes of compiled code and taking 41 seconds to compile itself.

Type Extension

Type extension is the facility to construct a new record type on the basis of an existing type. For example, say you have defined a type `Circle` in the following way:

```
TYPE Circle =
RECORD
       x,y,radius:
REAL
       END;
```

An extension of the type `Circle` might be

```
FilledCircle =
RECORD(Circle)
       fillcolor:
INTEGER
       END;
```

A record of the new type inherits the fields `x`, `y`, and `radius` from its "base type" `Circle` and then adds its own field called `fillcolor`. If you are a Turbo Pascal 5.5 or C++ user, this mechanism should be familiar, because the syntax employed is very like that used for defining object hierarchies in these languages. Indeed, you might think of type extension as being a "halfway house" to full object orientation, as it provides extensibility for data types but not for procedures (i.e., methods). In Oberon, the mechanism for encapsulating procedures remains the module, just as in Modula-2, and modules are not extensible.

To clear up some terminology: Type `FilledCircle` is called a *direct extension* of type `Circle`, and `Circle` is its *direct base type*. A new type called `BorderedFilledCircle`, which extends `FilledCircle`, would also be an extension of `Circle`, but not now a direct extension, because `FilledCircle` intervenes in the hierarchy. A type is also counted as an extension if it equals the base type, or, more formally, T′ extends T if T′ = T or T′ is a direct extension of an extension of T.

In Oberon, values of an extended type can be assigned to a variable of any of their base types. So you could assign records of type `FilledCircle` to a variable of type `Circle`; only the `x`, `y`, and `radius` values would be assigned. This is called a *projection* of the extended type onto the space of the base type. If you were to define a type `2Point` with fields `x` and `y`, and then extend it to type `3Point` with fields `x`, `y`, and `z`, then you can see that projecting a `3Point` to a `2Point` means just what it means in ordinary speech: The three-dimensional point *x,y,z* is projected as if onto a two-dimensional screen *x,y*.

Type extension in Oberon extends across module boundaries, so you can import a type from another module and then define extensions to it in the current one. This is the backbone of Oberon programming technique.

Extension applies also to pointer types, which in Oberon can only be pointers to record or array types. The type of a pointer to a `FilledCircle` is an extension of the type `POINTER TO Circle`, and so can be assigned to variables of that type.

This has important consequences when building complex dynamic data structures such as lists and trees. You can write a module that defines an abstract list structure, a base node type, and the procedures to access it. Then client modules can import and extend the base node type as required and add new procedures to access nodes of the extended type. This is like object-oriented programming in, say, C++, except that you must explicitly import the manipulating procedures rather than having them implicitly "inherited."

Here's an example taken from Wirth's 1988 paper "From Modula to Oberon." It's part of a module called `M` that defines a tree structure (which grows from a variable called `root` of type `Node`) and its search procedure:

```
TYPE Node =   POINTER TO Object;
       Object =  RECORD
                   key, x, y: INTEGER;
                   left, right: Node
                 END;

PROCEDURE Element(k: INTEGER): Node;
VAR p:Node;
BEGIN
    p := root;
    WHILE (p # NIL) & (p.key # k) DO
      IF p.key < k
      THEN p := p.left
      ELSE p := p.right
      END
    END;
    RETURN p
END Element
```

continued

BYTE ACTION SUMMARY

An Oberon Flyby

Oberon is the latest language creation from Niklaus Wirth, the father of Pascal and Modula-2. While smaller and simpler than its forebears, the new language allows you to define new data types as extensions of older types. Now available in the public domain, this new language could become an important addition to the world of programming.

This module manipulates trees in the abstract. Now you can define a client module that extends the type Object into some more directly useful types:

```
TYPE Rectangle =   POINTER TO RectObject;
     RectObject =   RECORD(Object)
                      width, height: REAL
                    END;
     Circle =       POINTER TO CircleObject;
     CircleObject = RECORD(Object)
                      radius: REAL
                    END
```

Because of Oberon's type-compatibility rules, you can assign pointers of type Rectangle or Circle to variables of type Node and so build trees whose nodes point to objects of mixed types. However, there is still a problem; you cannot yet retrieve RectObjects or CircleObjects from such nodes. All you can retrieve are Objects, which are mere projections with none of the interesting properties that you desire. What you need is some way to perform the reverse of projection and go back to the "wider" view. Oberon offers a type-safe way to do this, as I'll explain.

Type extension extends across module boundaries, so you can import a type from another module and then define extensions to it in the current one. This is the backbone of Oberon programming technique.

Guarding Types

When manipulating structures containing mixed types—like the previously considered tree—you need to be able to discover the actual type a node has become bound to at run time to know what fields it has. If, for example, a Node points to a Rectangle, you can retrieve its width, but if it points to a Circle, then you want its radius instead. However, the assignment-compatibility rule of Oberon, stated above, lets you assign a Rectangle to a Node (or a RectObject to an Object) but not vice versa. The answer to this problem lies in *type tests* and *type guards*.

The type test "p IS Rectangle" is a Boolean expression that is true only if p currently contains a pointer of type Rectangle. In general, t IS T′ is true if t (of type T) currently contains a value of type T′, and T′ is an extension of T.

Reverse assignments of base types to extended types can be made by applying a type guard. The assignment t′ := t(T′), where t′ is of type T′ and t is of type T (a base type of T′), is legal and can succeed if t currently holds a value of type T′. The (T′) is called the *type guard* of t. If the value of t is not of type T′ (nor an extension of it), then the guard fails and the program aborts; a failing guard is fatal, like an array-bound violation or a failing computer-aided software engineering selector.

Type guards look syntactically rather like C *typecasts*, but they could hardly be more different in intention; where Oberon demands that this must be the right sort of thing, and stops if it is not, C says, "Bend the thing to make it fit." The world may well end with a misplaced typecast.

Guards can be applied to assignments of record fields as well as whole records. All this may be easier to follow with a more concrete example. If W is a REAL variable, then the assignment

```
W := p(Rectangle).width;
```

is legal and succeeds if p does indeed contain a Rectangle pointer. It would fail and abort the program if p contained a Circle. If you had defined an extension of Rectangle called FilledRectangle, the assignment would also succeed when p contained a FilledRectangle (which is quite safe, because a FilledRectangle also has a width). Since aborting a program is to be avoided at all costs, type tests are used to make sure this never occurs. So in the tree example above, you might write an access procedure that contains lines like the following:

```
p := M.Element(K);
IF p # NIL THEN
    IF p IS Rectangle
    THEN Area := p(Rectangle).width *
p(Rectangle).height;
    ELSIF p IS Circle
       THEN Area := pi * p(Circle).radius *
p(Circle).radius;
    ELSIF ..........
```

To avoid having to write too many type guards, which is both verbose and inefficient for the compiler, Oberon employs the WITH statement (which loses the meaning it had in Modula-2) to assert that a variable has a particular type throughout a whole sequence of statements; this is called a *regional type guard*:

```
WITH p: Rectangle DO
    Area := p.width * p.height;
    Perim := 2 * (p.width + p.height);
    .........
END;
```

This should be enough of a taste of Oberon to show you that variant records are now completely redundant and that type extensions with guards offer a safer but also more powerful alternative.

Oberon also displaces the Modula-2 concept of *opaque types* used for information hiding with a more general concept. In a Modula opaque type, you export only the name of a type so that its representation remains hidden from the users of the type. In Oberon, you can hide part or all of a type by exporting only a partial definition or *public projection*. For example, a type

```
Box = RECORD x,y,width,height: REAL END;
```

might be exported as

```
Box = RECORD x,y: REAL END;
```





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Listing 1: *Extracts from a module by Robert Griesemer and Michael Franz that adds new functions (auto-indentation and cursor-controlled indentation) to the Oberon editor Edit.*

```
MODULE EdT;

IMPORT
  Display, Viewers, Texts, TextFrames, MenuViewers, Oberon;

CONST
  HT = 9X; LF = 0AX; CR = 0DX; Left = 01CX; Right = 01DX;
  Menu = "System.Close System.Copy System.Grow Edit.Store";

TYPE
  EdTMsg = RECORD(Display.FrameMsg)  (* a type extension *)
             text: Texts.Text;
             beg, end: LONGINT;
             time: LONGINT
           END;
VAR
  W: Texts.Writer;

(* Procedures BegOfLine, Select, Move, Newline defined
here... *)

PROCEDURE Handle(F: Display.Frame; VAR msg:
               Display.FrameMsg);
BEGIN
  WITH F: TextFrames.Frame DO
    IF msg IS Oberon.InputMsg THEN          (* a type test *)
      WITH msg: Oberon.InputMsg DO          (* a regional
                                             type guard *)
        IF msg.id = Oberon.consume THEN
          IF    msg.ch = Left  THEN Move(F,-1)
          ELSIF msg.ch = Right THEN Move(F, 1)
          ELSIF F.car > 0 THEN              (* caret set *)
            IF  msg.ch = LF THEN
                msg.ch = CR;
                TextFrames.Handle(F,msg)
            ELSIF msg.ch = CR THEN Newline(F)
            ELSE  TextFrames.Handle(F,msg)
            END
          END
        ELSE TextFrames.Handle(F,msg)
        END
      END
    ELSIF msg IS EdTMsg THEN
      WITH msg: EdTMsg DO
        IF (F.text = msg.text) & (F.sel = 0) THEN
           TextFrames.SetSelection(F, msg.beg, msg.end);
           F.Time := msg.time
        END
      END
    ELSE TextFrames.Handle(F,msg)
    END
  END
END Handle;

PROCEDURE Open;
VAR S: Texts.Scanner;
    T: Texts.Text;
    V: MenuViewers.Viewer;
    x,y: INTEGER;
    beg, end, time: LONGINT;
BEGIN
  Texts.OpenScanner(S, Oberon.Par.text, Oberon.Par.pos);
  Texts.Scan(S);
  IF (S.class = Texts.Char) & ( S.c = "^") OR (S.line #
0) THEN
    Oberon.GetSelection(T, beg, end, time);
    IF time > 0 THEN Texts.OpenScanner(S, T, beg);
                     Texts.Scan (S)
                END
  END
  IF S.class = Texts.Name THEN
    Oberon.AllocateUserViewer(Oberon.Mouse.X, x, y);
    V := MenuViewers.New(TextFrames.NewMenu(S.s, Menu),
                         TextFrames.NewText(TextFrames.
                         Text(S.s), 0),
                         TextFrames.menuH, x, y);
    V.dsc.next.handle := Handle     (* assignment of a
                                       handler *)
  END
END Open;

BEGIN  Texts.OpenWriter(W)          (* initialization *)
END EdT.
```

so that client programs can change the position, but not the dimensions, of a Box. Of course, a client can still define extensions to Box. The type of a nonexported record field can be hidden, too, so you can completely hide a sensitive data structure while still letting components of an exported type refer to it.

Apart from type extensions, tests, and guards, the only other additions Oberon makes to Modula-2 are multidimensional open arrays and *type inclusion*. The latter is a hierarchical relaxation of the type-compatibility rules so that if type T includes T′, values of type T′ are also values of type T and can be assigned to variables of type T.

Oberon supports five numeric types such that LONGREAL includes REAL, which includes LONGINT, which includes INTEGER, which includes SHORTINT. Hence, you can always assign an INTEGER to a REAL variable, or a SHORTINT to an INTEGER. This scheme almost removes the need for type conversions and dispels some of the more irritating aspects of Modula-2 (e.g., the incompatibility of INTEGER, CARDINAL, and REAL types).

Pruning Modula-2

Now I'll examine features of Modula-2 omitted from Oberon, and you'll understand why it was possible to exclude them. As you'll see, far more has been removed than has been added.

Variant records and opaque types are dropped, since the language's type-extension scheme is safer, more elegant, and more powerful.

Enumeration types—for example, `Colors = (red,blue, green)`—are not supported. They were originally introduced in Pascal to improve program clarity, but Wirth now believes that their indiscriminate use leads to an explosion of type declarations and to verbose programs. The values of an enumeration type have an uncomfortable, exceptional status; they are neither proper identifiers nor string constants available at run time. This causes an inconsistency in the rules of Modula-2, since you can't export an enumeration type's identifier without automatically exporting all its constant identifiers (as you can with other types). Enumeration types also posed problems in type-extending them across Oberon's module boundaries.

continued

Subrange types—for example, XCoord = 0..639—have been dropped, too. They were originally introduced to allow a compiler to generate guards for assignments and to economize on storage, but Wirth now thinks that their benefits are not worth the complexity they add to a compiler. Having lost these two types, it was natural to exclude user-defined set types and replace them with a single type SET whose values are sets of the integers.

Pointer types in Oberon are confined to record and array types. Array index types are no longer definable, and all indexes are integers. The lower bound of all arrays is fixed to 0, so you declare, for example, ARRAY 10 OF INTEGER. This simplifies bound checking, especially for dynamic arrays, and removes a rich source of programmer errors.

The FOR loop has been dropped completely, and you must use either REPEAT or WHILE with an explicit counter variable. The WITH statement used for record fields in Modula-2 is used in Oberon for type guards. When accessing record fields, you must always fully qualify the field name with its record name. This principle of full qualification extends to imports, too; the Modula-2 construct FROM M IMPORT x has been abandoned, and you must specify M.x for every occurrence of x in your program. Modula-2 experience has shown that this is preferable when many modules are imported.

The low-level features supported through the SYSTEM module in Modula-2 have been eliminated, along with the type-conversion functions, absolute addressing for variables, and the ADDRESS and WORD types. Oberon implementations are free to provide system-dependent modules, but these do not belong to the language definition, so such features are definitely implementation-specific and nonportable.

Concurrency, supported in Modula-2 through coroutines, has been removed. Wirth stresses that this is not a rejection of the need for concurrency in general programming; it reflects the fact that the Oberon-Ceres project was deliberately designed not to employ concurrency.

The structure of programs has been rationalized in Oberon. Modula-2's special main module, which has no definition part, has gone. It was an anomaly, because although it was actually a package of data and procedures, it had to act as a single executable procedure to the operating system. In Oberon, all modules are equal and can be compiled and executed. Under the Oberon operating environment, any parameterless procedure within any module can be executed as a "command" by typing its qualified name (e.g., MyModule.Start); this is how you invoke programs. If MS-DOS compilers for Oberon appear, this feature will present a problem, as DOS has no mechanism for executing parts of an .EXE file in this fashion.

The reserved words DEFINITION and IMPLEMENTATION have gone, and all modules begin in the same way with the word MODULE. Every module has an interface or definition text that is just an excerpt from the text of the module, containing copies of just those constant, type, and variable declarations and procedure headings that are to be exported. Local modules are dropped, as Modula-2 programmers seldom used them and they complicated the scope rules unnecessarily.

The total effect of these changes is to make Oberon's rules for handling modules simpler and more orthogonal than those in Modula-2, as every module is a complete compilable unit.

Oberon and Object Orientation

Earlier on, I said that Oberon was a "halfway house" to object orientation. You may well be wondering why Niklaus Wirth did not go the whole way, to a fully object-oriented programming system. It is certainly not for any want of OOP experience, for as well as sanctioning the development of Modula-3, Wirth and his coworkers have experimented with object-oriented extensions to both Modula-2 and Oberon by making modules into first-class objects that can have methods and instances.

However, Wirth remains unconvinced that encapsulated methods offer the best paradigm for programming large systems. OOP insists that all access procedures must be defined in the same place as the data structures they work on, which Wirth considers to be an unwieldy dogma. When developing large systems, he believes it is important to be able to add new procedures in later modules without being forced to define a whole new subclass, especially if this would involve recompiling the original class definition and all its clients. (To be fair, virtual method systems used in C++ and Turbo Pascal 5.5 make such recompilation unnecessary.)

In Oberon, it is procedure types rather than the procedures themselves that are contained in data structures (or objects) in the program text, and binding occurs at run time by assigning a procedure called a *handler* to a procedure type field in a record. Type tests enable a handler to discriminate among the various extensions of a base type while still maintaining strict data typing. (Listing 1 shows an example of a handler called EdT.Handle, which gets assigned in the last line of EdT.Open.)

Purely object-oriented languages like Smalltalk tend to be typeless. Variables can hold objects of any class (i.e., type), so the compiler cannot tell you if the wrong object has been put into a variable. The program may still do something sensible thanks to polymorphism, which ensures that different objects can do their "own thing" in response to the same message. For example, sending a Print message to a Rectangle object prints a rectangle. If you've put a Circle in there by mistake, the message will print a circle. This is close to the way in which the real world behaves; elephants do elephant things and oranges do orange things. But if an elephant finds its way into your orange squeezer, it will surely ruin your breakfast, and the fact that it does elephant things may prove to be a voluminous embarrassment rather than a consolation.

The ETH recently made public domain versions of Oberon available for the Macintosh, DEC's DECstation, and Sun Microsystems' Sparcstation. I for one am impatient to try the Oberon programming style. Above all, I just love the idea of a compiler that actually got smaller. ■

Editor's note: *The public domain versions of Oberon mentioned above are available on BIX, via BYTEnet, and on disk. See page 5 for details. For further information on Oberon, contact Michael Franz, Institut für Computersysteme ETH, 8092 Zurich, Switzerland.*

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Dick Pountain is a BYTE contributing editor, technical author, and software consultant living in London, England. You can contact him on BIX as "dickp."

Here's what they're saying about Ami Pro from Lotus.

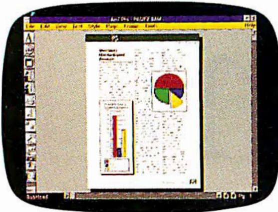
"

Independent User Survey For Windows.™*			
Word Processing Features	Ami Pro *for Windows*	Word for Windows	WordPerfect for DOS
Best Overall	50%	22%	16%
Ease of Learning	47%	28%	8%
Ease of Use	52%	23%	8%

"

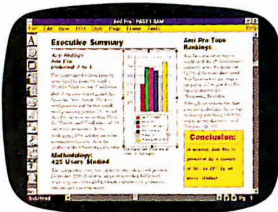
*Independently commissioned Windows word processor Usage and Attitude Study conducted November 1990

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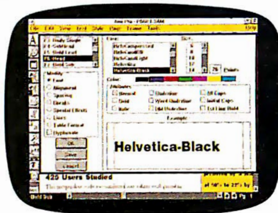
WYSIWYG

No wonder Ami Pro™ for Windows™ is getting rave reviews from users. They're naturally impressed by its 360 powerful features. And even more impressed with how easy it is to use them. Ami Pro has everything you expect in a power word processor, plus important features you can't find anywhere else—like truly interactive WYSIWYG that lets you edit in any of four page views, including full-page view.*



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Our exclusive "frames" feature lets you quickly place text and graphic elements where you want. Just position your frame anywhere on the page, then fill it with words, drawings or imported graphics. With a click of the mouse, your text automatically wraps around it.



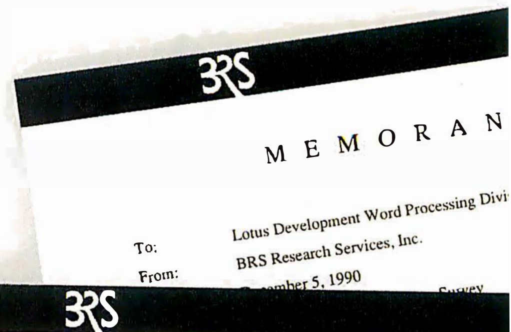
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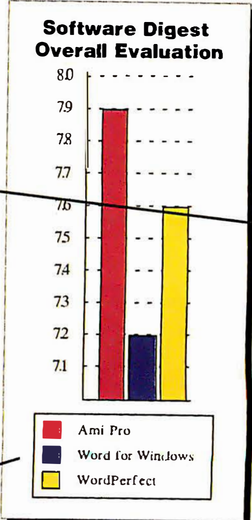


User Study Matches Expert Reviews

User preference research findings have a uncanny resemblance to what word processing and technology experts have been saying all along: Ami Pro is the new standard for word processing in the Windows environment.

The Software Digest rating, for example, places Ami Pro well above Microsoft's Word for Windows and WordPerfect in terms of overall performance.

The user research shows similar results. Ami Pro consistently outranked Word for Windows and WordPerfect in terms of



USER PF
WORD PRO

Executive Summa

Key findings:
Ami Pro preferred 2 to 1

Users prefer Ami Pro from Lotus more than 2 to 1 over Microsoft's Word for Windows and WordP

Half of the users studied ranked Ami Pro as the "Best Overall" Windows word processor and th overall word processing product. 51.9% said Ami Pro was easier than Word for Windows and WordPerfect; 47.3% said it was easiest to learn.

A whopping 63% said they are extremely enthusiastic about th product or like it better than a

Methodology: 42

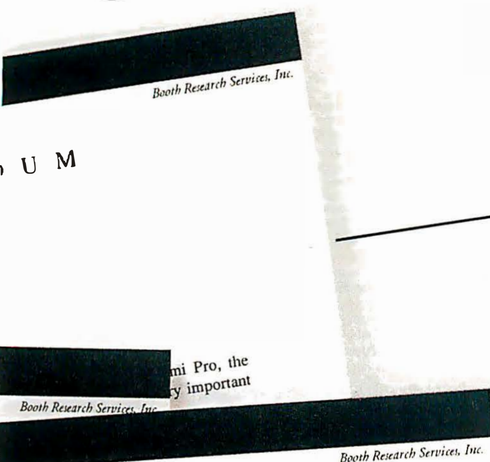
This independent study was c November, 1990. A random processing users were called f attitudes and user experience



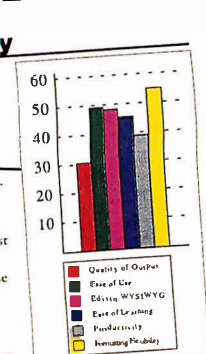
Easiest to Us

*Study results and complete questionnaire available by writing Booth Research Services, Inc., 1120 Hope Road, Suite 200, Atlanta, GA 30350. Enclose $100 plus $3.00 shipping and handling.

ey're saying it.



EFERENCE STUDY:
ESSING FOR WINDOWS



Performance Feature Ranking in Order of Performance

Ami Pro Tops Rankings

Ami Pro came out on top on nearly all of the 17 characteristics ranked by users. An impressive 51.9% of the respondents rated Ami Pro easiest to use, while a whopping 56.5% gave Ami Pro top consideration for "Formatting Flexibility".

Although not cited in this chart, users also ranked Ami Pro as tops in desktop publishing (60.3%), and in getting the most out of Windows (41.2%).

Conclusion:

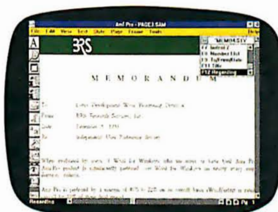
In general, Ami Pro is preferred by a margin of 50% to 22% by all users studied.

Users Studied

ucted over a three week period in ple of more than 1,000 word tailed interviews on preference,

FEATURES COMPARISON

Features	Ami Pro	Word for Windows	WordPerfect 5.1
Interactive WYSIWYG	Yes	Yes	No
On-Screen Font and Attributes	Yes	Yes	No
Auto Text Wrap Around Graphics	Yes	No	Yes
Editable View Levels	Yes	No	No
Global Style Sheets	Yes	No	No
Thesaurus Offers Word Meanings	Yes	Yes	No
Visual Dialog Boxes	Yes	No	No
Internal Chart Generation (10 Types)	Yes	No	No



STYLE SHEETS

Ami Pro comes with more than two dozen style sheets that have the page layout already set up and ready to go. So you can produce professionally designed business letters, memos, reports, presentations, newsletters and more—in just the time it takes to type in text.



EXPERTS AGREE

It's easy to see why users prefer Ami Pro from Lotus two to one over Microsoft® Word for Windows™ for overall features and ease of use. And why it's received top ratings from virtually all the industry experts, racking up such coveted awards as PC World's Best Buy. The Buyers Assurance Seal from InfoWorld. And PC Magazine's Editor's Choice.

"Ami Pro received a score in Ease of Use of the User Interface that was fully 10 points higher than the next highest score, and came in 14 points ahead of the score WordPerfect™ 5.1 drew from its buyers," according to PC Week's Corporate Satisfaction Poll.

PC Magazine says, "Ami Pro has the friendliest interface and the widest range of functions...[It] is easier to use than almost any program with comparable powers."**

Ami Pro is the word processing program that takes full advantage of the Windows environment, combining power word processing with the power to create professional documents fast. And with its icons and interactive features, Ami Pro is incredibly easy to learn and use. So what do you say? You've just learned about five major Ami Pro features.

Now to find out about the other 355—and how to get a free working model—turn the page.

Circle 258 on Inquiry Card (RESELLERS: 259).

This says it all.

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Automatic Timed Save
Block Manipulation
Bookmarks
• Named By User • Go To
Charting
• 3D Charting • Edit Chart with Draw Tools • Legends • Multiple Styles Per Type • 7 Chart Types
Copy Text and Graphics
Cursor Movement
• Begin/End of File • Character • Line • Page • Paragraph • Sentence • Top/Bottom of Screen • Word
Customizable Icon Bar
• Choose From Over 45 Functions • Quick Access to Features
Customizable View Level
• 10-400% • Fully Editable
Cut and Paste
Date Insertion
• Today's Date • Date Printed • Date Last Edited • Definable Style
DDE (Dynamic Data Exchange)
• Two-way • Paste Link • Text and Graphics • Via Macro Language
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• Backup Options • Date Styles • Dictionary Paths • Display Options • Document Path • Draft Mode Colors • Footnote Options • Hyphenation Hot Zone • Pair Kerning • Printer • Icon Bar Icons • Undo Levels • View Level
Delete
Dialog Boxes
Document Annotation
• Notes • Show/Hide • Go To Notes • Date/Time Stamp • Stacked Notes
Document Descriptions
• Author Name • Operator Name • Revision Number • Creation Date • Revision Date • Renameable Fields • User Defined Fields • Display with Directory • Print with Document
Drawing
• Cut/Paste Objects • Circles • Arcs • Squares • Rectangles • Rounded Boxes • Diagonals • Polygons • Polylines • Group Objects • Snap-To Grid • Fill Patterns • Line Widths • Text Rotation • Type Text
File Import/Export
• AdvanceWrite • ASCII • DBase • DCA Final Form • DCA Revisable Form • DIF • E-Mail • Enable • Lotus WKS, WK1, WK3 • Microsoft Word • Microsoft Word for Windows • Multimate • Navy DIF • Peachtext • Rich Text Format • Samna Word • Windows Write • WordPerfect • WordStar • Wordstar 2000
File Management Functions
• Copy • Rename • Delete • Move • Sorted File Listing
Font Control
• Unlimited Number of Fonts • WYSIWYG • Limited Only by Printer
Footnotes
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Math Calculations
Measurements
• Centimeters • Inches • Picas • Points
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Revert to Saved Version
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• Case Insensitive • Forward or Backward • Header/Footer/Footnote • Skip • Replace • Replace All • Search for Style • Search by Attribute • Wildcards
Section Outline Numbering
• 6 Levels • Number Paragraphs • Numbered Lists • User-Defined Reset
Snaking Columns
• Up to 8 Columns • Column Balancing • On Screen • Variable Width • Variable Spaced
Sort
• Alphabetic • Numeric • Ascending • Descending • By Paragraph • By Word • By Number of Lines • 3 Levels—3 Words Within each Level
Spelling Check
• 130,000 Word Dictionary • Add to Dictionary • Correct Multiple Occurrences • Entire Document • Selected Text • International Dictionaries • Rest of Document • Skip All Occurrences • Statistics Report • Unlimited User Dictionary Size
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*offer expires April 15, 1991. InfoWorld's Buyers Assurance Seal awarded August 13, 1990 to Ami Pro 1.2.

Circle 260 on Inquiry Card (RESELLERS: 261).

Smart Memories

What happens when memory chips start to think for themselves? A look at content-addressable memories and beyond

PETER WAYNER

The good news, it's been said, is that in the future, all the world's information will be available on-line. The bad news is that this file will be terabytes long, and you'll have to use a string-search algorithm to find what you're looking for. Moving data has always been one of a computer's strong suits. But even when given processors that can perform 100 million instructions per second, computers can't keep up with the proliferation of data coming out on CD-ROMs.

Now, some researchers have created smart memory chips that have thousands of tiny, 1-bit processors built in at each memory location. These chips have applications not only in data retrieval, but also in unexpected areas of CAD, graphics, and robotic planning.

Computer memory is a one-way street. If you know the location you want, the memory can quickly deliver the value stored there. If you're looking for a particular value, however, the computer needs to step through every location to find where that value is stored.

One big bottleneck in current microcomputers is between the CPU and the memory. Before it can perform a computation, the CPU must receive the necessary information. This delay is often acceptable for computationally heavy scientific operations, but it is a major impediment for light processing problems such as text searching.

One solution is a *content-addressable memory* chip, a special memory chip manufactured by companies like Advanced Micro Devices (AMD). CAM chips are available in simple forms or in more complicated versions such as the MIT-built Database Accelerator (DBA) and Coherent Research's Associative Processor (aka the CP or the AP). The basic technique at the heart of these circuits dates back to the 1950s. Real implementations are scarce, however, because the technology of VLSI has only recently made the chips a viable option.

The First Step

The core of the CAM circuit is a memory cell that can store a value and respond to a query such as "All cells with a 1 stored in them, raise your flag." The flags in the cells that make up one word of memory are cascaded. If all the flags are raised, a word-size match flag is also raised. The system decodes the address by finding the first raised flag.

Most implementations signal if there is more than one match but report the first matching address in numerical order. This way, whole words can be searched for in

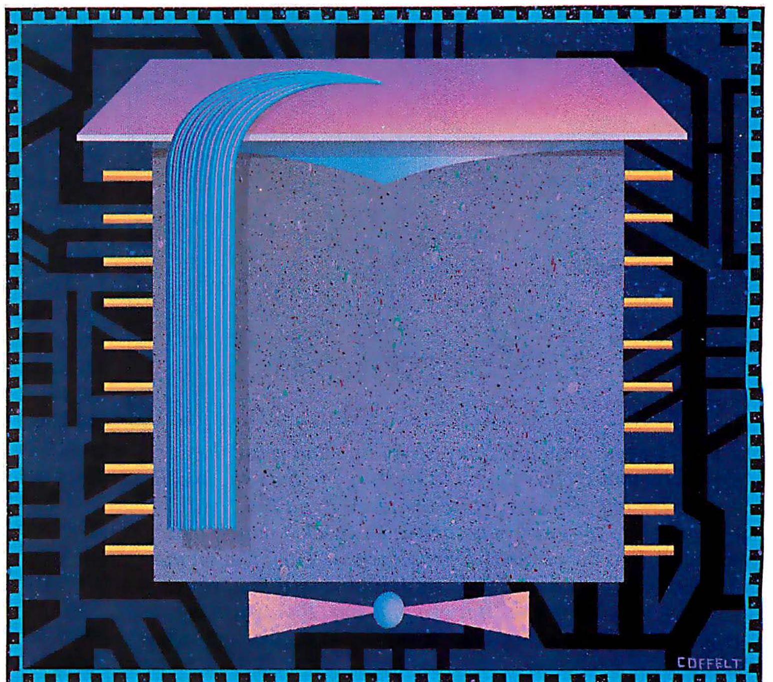


ILLUSTRATION: KEN COFFELT © 1991

reverse. You need to know only the value, not the location.

Figure 1 shows a diagram of a normal static RAM (SRAM) cell and a CAM cell. Each can store 1 bit of information. Notice that the extra transistors in the CAM cell can be activated by flipping the *Match* line, which causes the signal line to stabilize to a 1 or a 0 depending on the value stored in the cell. The values from each of the cells can be cascaded together with AND gates so entire words can be matched. These word-size cells can be arranged in arrays and searched in parallel.

If multiple memory words match, the chips break the tie and return the match with the lowest address. Many chips also contain bits that force the match operation to mask certain words. Called *skip-bits*, they can be used to retrieve the multiple memory words that match. First, the word with the lowest address is read out; then, its skip-bit is flipped on, and the match is redone. This time, the second-lowest address comes out. This process is repeated until all the matches have been returned.

The interface between the CAM chip and the outside world can take many different forms. For instance, the memory can be directly addressable like regular memory, or it can be set up as an independent store with a tiny processor acting as a guard. Four-bit op codes control the AMD CAM chip. They command the store to perform matches, copy data between the I/O lines and a specific location in the array, and clear the array.

Today, the typical use for CAM chips is in network-routing applications. Often a star-like bridge joins several branches of a network. If a packet with an address comes in from one branch, the router must determine on which branch to send it out.

This process takes only one step if all the addresses are loaded into a CAM chip. After one match step, the CAM chip matches the address and returns the address of the correct branch on which to send the packet out. What once required one step per entry in the table now requires one step overall. Operating systems perform many other similar table lookups.

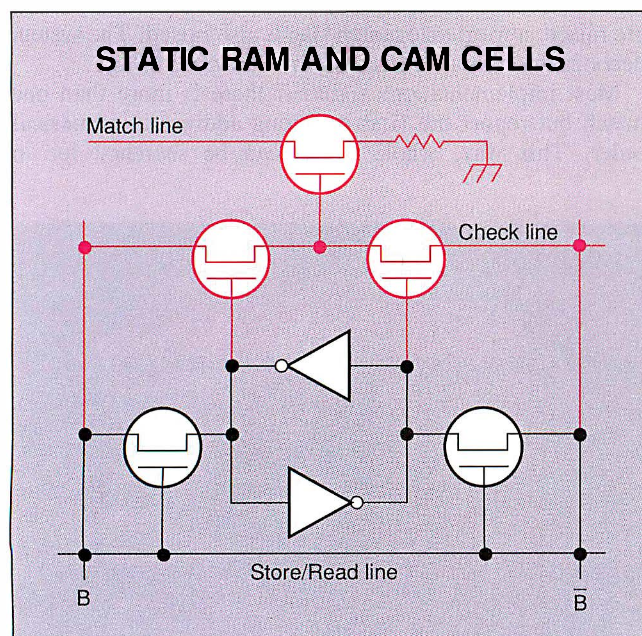


Figure 1: *To read, raise the Store/Read line and sense the voltages of B and $\overline{B}$. B is the bit to be stored in the cell, and $\overline{B}$ is its complement. To store, raise the Store/Read line, and drive B and $\overline{B}$ to the correct polarity. To check a match (red lines), set B,$\overline{B}$ to the polarity to be matched. Then flip on the Check line. To find out if B is 1, set B high and $\overline{B}$ low. Note any drop in the Match line. If it grounds out, B matches the value stored in the memory cell. Store and Read work the same as in the RAM cell.*

Adding Some Intelligence

CAM cells might be good enough for some applications, but more can be done with the addition of some processing power. One solution is the CP, a commercially available machine marketed by a company called Coherent Research (Syracuse, NY). Another solution, the DBA, is a similar machine being built experimentally at MIT by a team including Charles Sodini, Jon Wade, Sharon-Marie Britton, and Cornell's Richard Zippel.

DBAs are CAM arrays with an extra 1-bit microprocessor attached to each word of memory. In other words, they are massively parallel computers containing simple processors and a word of memory in each node. They can combine results of matching computations using operations like AND or OR.

Figure 2 shows a block diagram of the CP. Each node has one line of CAM containing 36 bits. There are five bit registers and a function calculator, which computes values based on the combinations of bits according to the latest instruction word. Lines connect each node with the node above it and the node below it in an array. The DBA is constructed similarly but contains four bit registers. Zippel has proposed adding regular SRAM to each node or completely replacing the CAM with RAM.

Wild cards can significantly expand the power of the matching process. An additional feature of the CAM cells allows bits to be masked by including a third bit (called a *trit*), which matches a 0 and a 1.

Using this feature, let "*" stand for this third, ambiguous case. You can present CAM arrays with commands to look up words such as 100***1, which in this case could match eight different words, including 1001001 and 1000111. One advantage of including processors at each cell is that simple calculations on the data can be done locally and in parallel.

What follows is an example of how a 64-bit match is performed on this architecture. The search is more difficult on a generic CAM because it is longer than the word length, but the processing power of a DBA or a CP can overcome this hurdle.

On a generic CAM, since each node has less than 64 bits, the 64-bit words are split into 32-bit halves and stored in adjacent words. First, bits 0 to 31 of the match words are compared, and matches are stored in one of the registers. This operation saves the time of searching the entire memory array. Next, the main CPU reads out this location and searches for the second 32 bits. Finally, the CPU makes sure that both matches are next to each other in the array and thus correspond to the same 64-bit chunk. If there are multiple matches, the CPU must repeat the process.

The main benefit the DBA and CP provide is the communication lines between the processors. They can pass the match values to the next cell in line. When bits 32 to 63 are matched, the value from the neighboring register is passed along the communication line, and the AND value of these bits is computed. Adding the extra registers and 1-bit processor lets this larger match be performed on-chip without sending the information to the main CPU.

The registers can also be used to perform operations such as `greater than` or `less than`. For instance, if you want to find all words greater than 10101101, you can perform a search by combining the results of three queries: "11******," "1011****," and "1010111*." If any of these matches is true, then the word is greater than 10101101. In this example, three queries were needed, but in general, one query is used for every 0 bit in the *bounding* word (a word that defines the boundary of

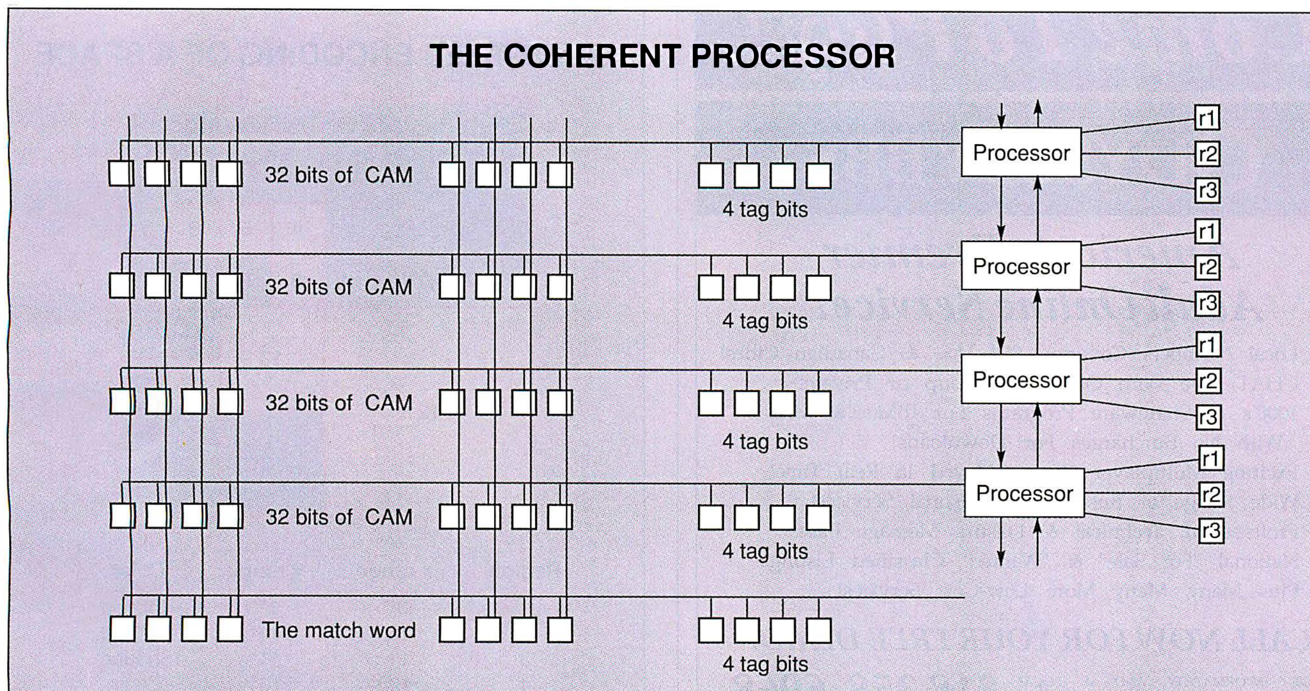


Figure 2: *A block diagram of the Coherent Processor shows that each node of the processor has 32 bits of regular content-addressable memory. Each node also has 4 tag bits (similar to CAM bits but individually addressable), three registers, and a processor that can determine if the entire line matches the bits in the match word. The cells are connected by a one-dimensional topology, and each can pass messages to either of the adjacent nodes.*

an area). If the `less-than` function is being computed, the 1 bits are converted into *don't care* (wild-card) asterisks.

Since these operations potentially require one match per bit, some chip designers are considering building this type of machine with RAM cells instead of CAM cells. In this case, the matching ability of the CAM cannot be used, and the processor must access each bit individually to determine whether a bit is a 1 or a 0. Then, the algorithms must use one cycle for each bit in the word and cannot use any of CAM's inherent parallelism. Standard RAM cells are well understood and smaller than CAM, thus making higher-density chips possible.

Using This Extra Power

As you can see, simple operations can increase the power of database searches—a valuable and obvious use of the DBA machine. The processing power can also be harnessed in nonobvious ways to speed up many computer tasks, one of the most straightforward being to determine whether a point is inside a polygon. This computation is repeatedly performed when matching a mouse-click to a window or, in the case of drawing programs and CAD, to an object in the window.

The polygon can be decomposed into a union of half-planes defined by lines. The location of the point is computed relative to all the lines in parallel. If the point is on the inside of the lines making up the boundary of a polygon, then it must be inside the polygon. If the polygon contains more lines, the comparisons can be performed in one step.

If the problem changes slightly so that the goal is to identify all points within a boundary, the task becomes *polygon filling*, an important application for computer graphics. Coherent Research implemented a version of this solution using several data structures that exploit the architecture of the CP. The following examples show some of the tricks that make good use of the system.

If you want to "fill" using the processor, you can use a slightly different technique to represent the black and white regions of a plane. For this exercise, consider these regions as a sequence of different-size squares—a representation known as a *quad tree*. Each of these squares is represented as four numbers: the minimum *x* and *y* and the maximum *x* and *y*. Figure 3 shows a typical definition of a region.

These representations can exploit the *don't-care* bits system so that the minimum and maximum values of an *x* or *y* range can be compressed into one number. For instance, a range between 8 and 15 can be represented as 01***, while a range between 30 and 31 becomes 1111*. The difference between the top and bottom of the range must be a power of 2. These numbers are *trinary*, meaning binary numbers plus the wild card.

The construction of such a constrained definition of a region is not difficult—in fact, it is

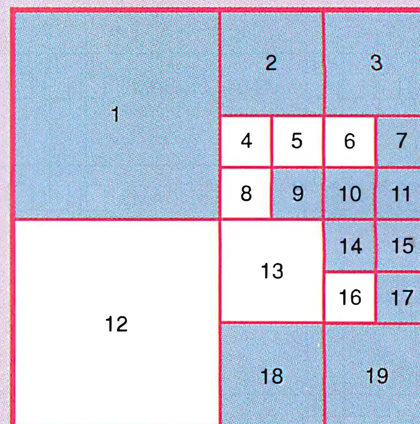
BYTE ACTION SUMMARY

Making Memory Smarter

Many applications run into a bottleneck when it comes to memory. One solution lies in making memory chips smarter. Content-addressable memory (CAM) promises to speed up operations such as database lookups and determining the location of a point. So-called "smart" memory chips may someday be as widely used as math coprocessors are now.



QUAD-TREE ENCODING OF A SPACE



Region	x range	y range	Color
1	0**	1**	Shaded
2	10*	11*	Shaded
3	11*	11*	Shaded
4	100	101	Clear
5	101	101	Clear
6	110	101	Clear
7	111	101	Shaded
8	100	100	Clear
9	101	100	Shaded
10	110	100	Shaded
11	111	100	Shaded
12	0**	0**	Clear
13	10*	01*	Clear
14	110	011	Shaded
15	111	010	Shaded
16	110	010	Clear
17	111	011	Shaded
18	10*	00*	Shaded
19	11*	00*	Shaded

Note: * = Either 0 or 1

Figure 3: *A quad-tree is a way to recursively describe a region so that it can be stored efficiently in the content-addressable memory cells.*

easy to do recursively. Begin with a square region with side length equal to a power of 2. (If it isn't a power of 2, pad it.) Then, recursively execute this process.

If a square is all one color, add the coordinates of the square to the definition of that color's region. If it is composed of different colors, split the square into four subregions and recursively repeat the procedure on each. Since the process begins with a square whose sides are powers of 2, the sides of all the recursively defined squares will also be powers of 2 and represented by a trinary number. The region shown in figure 3 was recursively constructed.

The resultant definition may seem overly complicated. There are numerous advantages, however, when it is used on a CP or a DBA. If, say, you want to find out which square a point resides in, simply query the point, and the correct range will respond. For example, a point (9,23) or (01001,10111) will fall in the ranges (8–11,20–23) or (010**,101**). If you want to find out what lies on the boundary to the right of this square,



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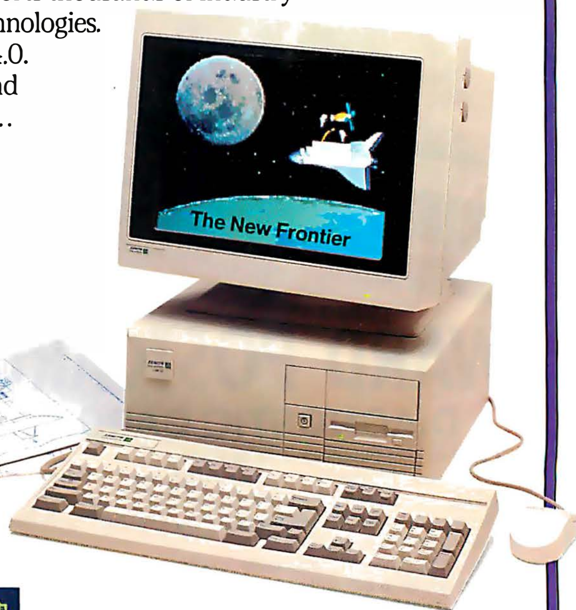
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create a rectangular range that borders the square. The range (12,20–23) or (01100,101**) lies to the right of (8–11,20–23) or (010**,101**). If you query the DBA for this range instead of a point, all bounding squares will respond.

Robotics via Databases?

By using a *brushfire* algorithm (an algorithm starting at one place and spreading), you can find bounding squares that locate the extent of a region. First, a point is identified and marked. Then, all neighbors of this point are marked, the neighbors of those points are marked, and so on. You can use this procedure for region filling with image and draw programs.

Another twist is the use of brushfire painting in robotics. Imagine that the region to be filled is not just a boundary to be filled with paint but the outline of a floor plan to be navigated. The process begins at the point where the robot is standing. All reachable regions can be computed just by starting a brushfire at this point and letting it mark the domain.

You can also use this process to find the shortest path in the specified domain if the algorithm keeps track of the step when a square was marked. That is, the starting spot is labeled with a 1. Its neighbors receive a 2, the neighbors of the 2s receive a 3, and so on. To find the shortest path between the starting spot and some other point x, use one query to find the square that contains x. This square has a numerical label, say 9, which means that it is nine squares from the starting square and next to a square labeled 8. You can find this neighbor marked with an 8 by searching with four queries. You can repeat this procedure following the decreasing labels 7, 6, 5, 4, 3, 2, and 1, just as Hansel and Gretel did with pebbles.

Value-Added

It is easy to see how this special smart memory could be used to speed up the handling of database problems. Surprisingly, you can use these processors for other applications when you exploit the low-level processing power bundled with machines such as the DBA and the CP. The smart memory begins to look like that of the Connection Machine, or CM (Thinking Machines), the Maspar Machine (Maspar Computer), and other massively parallel machines whose thousands of processors execute the same instruction in each cycle.

In fact, the processors on the CM are not much more powerful than those in the DBA and the CP. The CM processors also are 1-bit machines, and the processors on the CM-2 can do floating-point math. The major difference is that the CM has a 12-dimensional hypercube network connecting its processors, while the DBA and the CP have only a one-dimensional interconnection scheme. Thus, communication is faster on the CM. The trade-off is that all the connections take up silicon real estate and limit the density that can be packed on a chip.

The CM has 16 processors on a chip; the CP has 256. Zippel estimates that mass-produced chips could be made with $\frac{1}{16}$ the number of bits of current DRAM chips. In this era of 4-megabit chips, a sophisticated design could pack 8192 processors on a chip if each processor had access to 32 bits of CAM.

It is conceivable that addressable memory or architectures like the DBA will become commonplace on small computers. The smart memory can speed up database lookups, which is the main job of many machines. The benefits don't stop there, however. You can create other algorithms for graphics and robotics like the ones I described. These specialized memories can be thought of as parallel processing on the cheap. ■

Peter Wayner is working toward a Ph.D. in computer science at Cornell University. He can be reached on BIX as "pwayner."

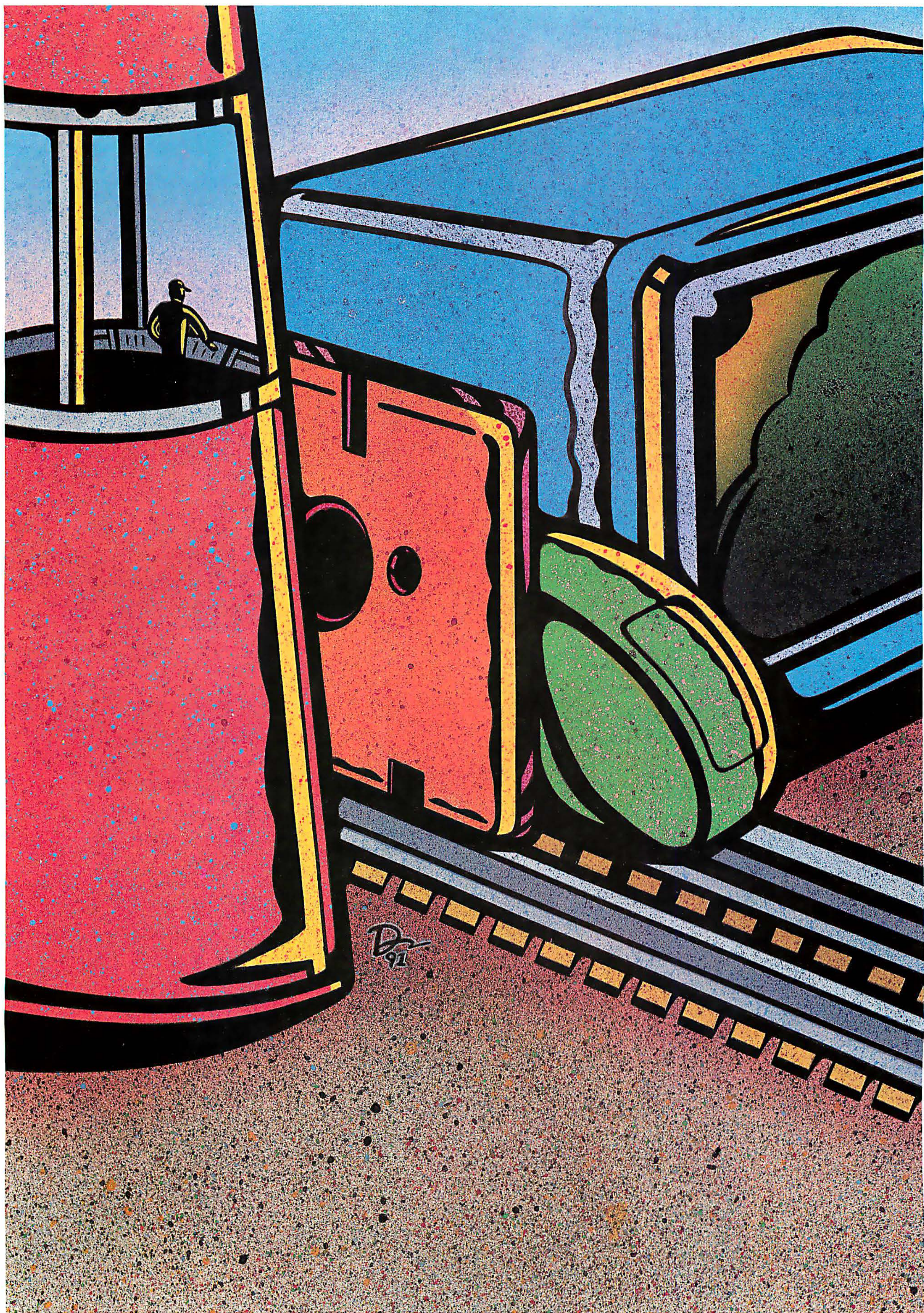


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NETWORK MANAGEMENT

Today, network management is as much a black art as a science. As networks grow to service dozens, then hundreds, then thousands of users, many in remote locations, the job of keeping the system up and running requires as much intuition and luck as it does knowledge and experience.

Look at any midsize organization today, and you're apt to see a kaleidoscope of networks. Engineering might be running TCP/IP over Ethernet, while Finance runs NetWare over Token Ring and Marketing uses AppleTalk. As Peter Stephenson points out in "Mixing and Matching LANs," the biggest challenge in managing networks today is not setting up and supporting stand-alone LANs, but interconnecting LANs that use disparate media and protocols. Stephenson discusses the need to find or create common ground between networks.

Once LANs are interconnected, managing a distributed network can seem as impossible a task as taming the Hydra: You solve one problem, and two more appear in its place. In "Dynamic and Distributed," Carl Manson and J. Scott Haugdahl describe many of the tools and methods available that can transform you into a distributed network management Hercules.

A primary reason for interconnecting computers is to provide central services. Setting up and managing such services, however, involves more than slapping a shared storage subsystem or printer onto the network. As Jeffrey Sloman points out in "Control Central," providing a central service usually (and paradoxically) means spending more time managing the clients than managing the server.

The Holy Grail of network management is a standard protocol used by all the devices on the network to inform a management workstation of the configuration and status of the various nodes. Most network vendors provide such a protocol for their individual environments but fail to provide internetwork solutions. Two standards that do provide such solutions are SNMP and CMIP. In "Dueling Protocols," Sharon Fisher compares these two standards and discusses the obstacles in the way of their general acceptance.

What standard management protocols promise for tomorrow is available today, but only if you stick to the products of a single vendor. One such vendor is, of course, IBM. In "Managing Big Blue," Barry Nance examines the management technologies used in IBM's network offerings, both large and small.

In many networks, the big issues concerning standards and protocols take a backseat to the ever-present challenge of keeping the network up and running every day. In "Finding Fault," Steven M. Dauber describes a systematic approach to identifying and rectifying problems on a LAN. His central thesis is that you should avoid jumping to conclusions about network problems, because the obvious answers often turn out to be wrong in a network environment. In a related text box, "Let's Get Physical," John Kaiser takes an in-depth look at tools that let you track a network's infrastructure.

Network management is in a state of flux as customers are demanding internetworking products built on standards and vendors scramble to provide them. Management protocol standards are clearly the solution, but the migration of existing systems to these standards may prove painful and expensive. When the dust settles, however, managing a network will be a more systematic enterprise, and few will mourn the passing of the days of black magic.

—Bob Ryan
Technical Editor,
State of the Art



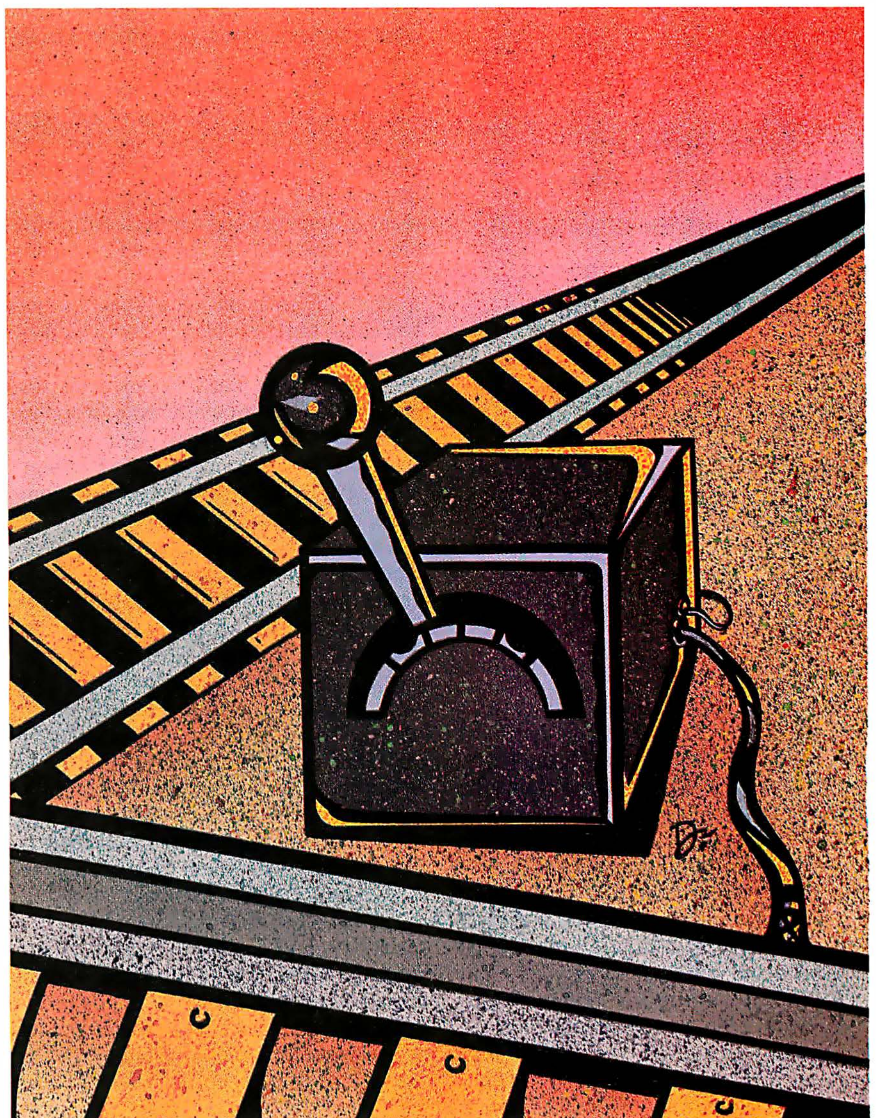
MIXING AND MATCHING LANS

The primary problem for network administration is not how to set up LANs, but how to interconnect them

PETER STEPHENSON

Networks composed of other networks are becoming the rule rather than the exception. Most LAN manufacturers sell more small LANs than large ones; the average-size LAN has 6.3 users, and within a large organization, there may be literally hundreds of these 6.3-user networks. Someday, someone in the organization is going to decide that these "average" networks should talk to each other, and whether you like it or not, you are then going to have a heterogeneous network.

Heterogeneous networks are composed of several network segments that may differ in topology, protocol, or operating system. They may contain PCs operating on Ethernet or Token Ring, Unix workstations running on TCP/IP, and mainframes running any of several large-platform protocols, such as IBM's Systems Network Architecture (SNA). Most of these systems were originally designed to communicate only with their own kind on a homogeneous network, so seamlessly tying together all the different network segments in a large organization remains a nearly impossible task. To allow these relatively unrelated networks to evolve into a single working system, you need a clear understanding of both the issues surrounding mixed networks and the fundamentals of network communications.



Basic LAN Issues

Before you can deal with the task of mixing topologies, protocols, or operating environments, you need to understand these basic network characteristics. The topology of a network is the way in which the devices on the network are physically

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interconnected. You can connect network elements on a bus, in a ring, or as a star. The name of the topology describes its physical layout. But there are additional considerations that blunt the simplicity of this description.

For example, depending on the signaling characteristics of the protocol using a particular topology, the medium (i.e., cable) can differ significantly from implementation to implementation. A bus topology that requires very fast data rates might use fiber-optic media, while a slower bus may only require shielded twisted pair. A full description of a topology needs to consider aspects, such as signaling characteristics, that go beyond physical layout.

The next fundamental LAN characteristic is the protocol. A protocol is a set of rules for communication that includes a pattern or format for data and a procedure for its transfer. But, like topology, protocol is much more than a simplistic definition suggests.

BYTE ACTION SUMMARY

Tying Different Networks Together

Various issues must be addressed when you connect dissimilar networks, such as connecting and communicating with different topologies, protocols, and networking models. You can solve some of the problems by various "black box" technologies.

Most network users are familiar with ARCnet, Fiber Distributed Data Interface (FDDI), Ethernet, and Token Ring, yet these represent merely the tip of the protocol iceberg. They are low-level or access protocols and only work at the bottom two layers of the ISO Open Systems Interconnection (OSI) model. They allow network devices to connect to each other and communicate with higher-level protocols, and not much more.

That doesn't minimize the importance of access protocols—they are the most familiar and visible protocols. But the real work on a network is carried on at the higher levels of the OSI model using higher-level protocols. It is these protocols that permit the existence of heterogeneous networks.

Common Ground

The ability to create a heterogeneous network rests on two requirements. First, you must be able to interconnect topologies. Second, you must be able to transfer information between dissimilar systems of communication—meaning that at some point you must use a common protocol. There are many ways to accomplish this; most of them make use of common high-level protocols for moving data between common layers on a communications model such as OSI or TCP/IP. Tools for internetworking, such as bridges, routers, brouters, and gateways, make extensive use of this ability.

To put it simply, you can mix different topologies and protocols only if you have an internetworking scheme that allows you some common point of reference. That point of reference might be a high-level protocol common to two networks that you wish to interconnect; a device that allows interconnection of different topologies with different physical and electrical characteristics; or a protocol that lets you ignore operating-environment differences and connect, for example, a DOS LAN to a network of Unix workstations.

You can envision heterogeneous networks as building blocks connected by "black boxes." The building blocks are discrete physical network segments that usually have their own servers, workstations, and other network devices. They consist of a single protocol and a single topology. By themselves, they are complete, encapsulated LANs.

To connect two of these discrete segments, you must cross a boundary. Some device must fly over, break through, or tunnel under the wall between one network and the other. The device—the black box—does not change either network; it simply transports packets of data between them. It satisfies the physical requirements of both networks. It also has to transport the data safely from one network to another and unpackage the data until the receiving network can read it. Deep in the packet, data must be in a format common to both networks.

In the case of wide-area support, a black box must be able to deliver data to some common long-haul system, control transmission to a similar black box on the other end, and then continue as if the two networks were in the same building. The inclusion of large platforms such as VAXes or IBM mainframe computers adds complexity, but success here also depends on using the right black box.

Interconnection Strategies

Most often, heterogeneous networks are unplanned. They appear when someone in a large organization decrees that all the existing networks in the organization should interconnect. The challenge is to take several dissimilar LANs and get them all talking to each other. The trick is to consider these dissimilar systems in two ways.

The first step is to interconnect the LANs that communicate easily. Only then should you consider the ones that are so dissimilar that they cannot commingle easily. In interconnecting LANs, you look for common denominators in protocol and topology. You then choose a single medium to connect the segments that are physically close together; these LANs become physical segments on a larger logical network. The medium chosen must provide for the increased traffic load of the new, larger network as well as offer the most painless physical interconnection possible.

The final step is to consider the geographically dispersed segments. Here, you have to select the long-haul medium best suited for each segment and deliver that segment's data in a format that the home system can use easily.

Interconnecting LANs is easier if your organization has stuck to widely accepted standards instead of proprietary topologies and protocols. (The exceptions are the de facto standards NetWare and ARCnet.) If your organization has areas that are not standards-based, you have an important decision to make: Either live with the existing system, or tear it out and start over.

For example, many companies have decided to adopt the Synoptics LattisNet unshielded twisted-pair network, which conforms to no accepted standard and doesn't connect well to other networks. Now that a UTP standard—10BaseT—exists, LattisNet users have to decide whether to support the standard or keep their proprietary system. Anticipating this dilemma, Synoptics has developed an excellent system for promoting coexistence between the two systems. In effect, it has provided the black box.

Black Magic

Bridges, routers, brouters, and gateways are the black boxes that enable you to use different topologies and protocols within a single heterogeneous system. Each has strengths, weaknesses, and specific applications.

Bridges have distinct uses. First, they can interconnect network segments using different physical media; for example, it is not uncommon to see bridges between fiber-optic and coaxial cable. In addition, they can accommodate dissimilar low-level (physical and data-link layer) protocols. Thus, under the right circumstances, you can use bridges to connect similar segments, such as two Ethernet segments, or to mix dissimilar segments, such as a Token Ring segment and an Ethernet segment.

Bridges also feature high-level protocol transparency. They can move traffic between two segments over a third segment in the middle that cannot understand the data passing through it. As far as the bridge is concerned, the intermediate segment exists for routing purposes only. Finally, bridges allow devices and segments using the same high-level protocol (e.g., TCP/IP or XNS) to communicate, regardless of what low-level protocol or physical-layer standard they are running.

Bridges are intelligent. They learn the destination addresses of traffic passing on them and direct it to its destination. This explains their importance in network partitioning: When you find that a physical network segment has excessive traffic and its performance is beginning to degrade, you can break it into two physical segments with a bridge. The bridge directs the traffic to its ultimate destination, limiting traffic that is not intended for a given segment. Bridges use a process of learning, filtering, and forwarding to keep traffic within the physical segment it belongs in.

Because bridges must learn addresses, examine packets, and make forwarding decisions, they often exhibit mediocre performance. In fact, performance is one issue you need to consider if you plan to use bridges. But in mixed protocol environments, bridges can be truly useful black boxes.

Routing Traffic

The next type of black box is the router, which, in some respects, is smarter than the bridge. Routers don't have the same ability to learn as bridges do, but they can make routing decisions that determine the most efficient data path between two network segments.

Routers don't care what topologies or access-level protocols the network segments are using. Since they operate at the next layer above bridges—the network layer—they are unconstrained by medium or access protocols. Unlike bridges, routers do not view a heterogeneous

network from end to end. Bridges know the ultimate network destination; routers only know where the next router is. Routers are usually used between network segments that use the same high-level protocol.

Bridges make a forward or discard decision on each packet of data, depending on whether the pack is destined for an address on the other side of the bridge or not. Routers choose the best route for the packet by checking a routing table. They see only the packets addressed to them by the preceding router or the network's end station, while bridges must examine all packets passing on the network. However, as it turns out, today's bridges take those issues into account and in most cases actually offer better performance than routers.

Most large internetworks can make excellent use of routers. However, you should remember that routers prefer the same high-level protocol in all the network segments they connect. Often, for the network that "just grew," that is not possible. If you are connecting networks in a multiprotocol environment, you are probably better off using bridges. The same is true if you wish to segment an existing network to control traffic loads.

If you are connecting over wide-area networks (WANs) and you control the connection (i.e., you are not using a public data network or a packet-switched network that requires a gateway), you will probably find that routers can help control traffic flow. Often, you need to opt for a combination of bridges and routers to help you solve both routing and multiprotocol issues.

Brouters are a kind of hybrid of bridges and routers. Often referred to (incorrectly) as multiprotocol routers, brouters provide many of the advantages of both bridges and routers for very complex networks. True multiprotocol routers do not contain the bridging advantages of brouters; they simply allow the router to do what routers do with more than one protocol. Brouters actually make a decision on whether a packet uses a protocol that is routable. It then routes those that it can and bridges the rest. Brouters are complex, expensive, and difficult to install, but for very complicated heterogeneous networks, they often provide the best internetworking solution.

Wide-Area Interconnects

Gateways operate on the top three layers of the OSI model (session, presentation, and application). They allow the most sophisticated method of connecting network segments and networks to hosts. You select a gateway when you have to interconnect systems built on totally different communications architectures. For example, you would use a gateway to interconnect a TCP/IP LAN to an SNA mainframe. The two architectures have no commonalities, so the gateway must translate all the data passing between the two systems.

One common use for gateways is connecting to a long-haul system, such as an X.25 packet-switched public data network. The X.25 segment provides a protocol that routes data packets between two network endpoints without regard for the protocols passing on it. At either end of the network, the gateway provides the protocol conversion to and from the network segments connected on its other side. Gateways provide no packet routing within the network segments; they simply deliver their packets of data so that the segment can read them. When they receive packets from the segment, they translate them and route them to the distant-end gateway, where the packets are retranslated and delivered to the distant end's network segment.

Planning a Heterogeneous Network

If you have the luxury of planning your network from scratch, you have several issues to consider. The most important is coming up with a definition of the overall objectives of your new system.

Usually, such a definition boils down to interconnecting several workgroups with different individual needs. Thus, it's usually a good idea to begin your macro definition with a micro examination of individual needs. Don't, for example, begin by considering how to tie the various campuses in your global system together. Instead, begin by considering the needs of the accounting department in a single location. Once you've sorted out individual needs, you can begin exploring for that commonality that makes interconnection possible. It begins with considering how a single topology or set of topologies and a single protocol or suite of protocols might be used consistently throughout your system.

Once you have some idea of how to satisfy workgroup needs and the common connectivity threads that run between them, consider the best way to connect the individual workgroups into compact network segments. The next step is combining the segments into a single network within a single location. In most cases, conventional wisdom and simple solutions work fine at this level.

The exceptions are cases where you have special needs. One such exception is the inclusion of Unix workstations in a network composed mainly of PC LANs. You are likely to find this in companies using such systems as Sun or Hewlett-Packard workstations in an engineering or scientific environment. In this case, you'd have to use a bridge and some common high-level protocol like TCP/IP. Some products are available to help with this problem; one for Token Ring LANs is the p4100+ multiprotocol bridging router from Proteon in Westborough, Massachusetts.

Once you have successfully connected individual locations, your next step is to consider connections between locations on the same campus. Now you'll find that you must contend with traffic flow. Assuming that you have planned with consistency, your major challenge is data throughput. Throughput issues revolve around two things: how fast your data can travel between locations, and how congested the routes between locations become.

You can solve the raw-speed issue by considering various metro-area medium choices. If your campus is not too widely dispersed, 100-megabit-per-second FDDI fiber optics makes a very good system backbone. Otherwise (e.g., if your buildings are on opposite sides of town), you may need to consider something like T-1 dedicated lines.

Your final planning is for long-haul wide-area connections. Again, there are two major considerations, but this time they are variations on the theme of the individual campuses. Long-haul systems are expensive. If you use a public data network, the inconsistencies of traffic and system reliability now come to bear on your data throughput. You must consider your own methods of traffic routing; for example, you may want to route traffic between your New York office and your L.A. office through both Denver and Dallas.

Using a technique called the *spanning tree algorithm* (part of the IEEE 802.1 internetworking standard), you can place bridges between both long-haul routes. A *spanning tree* is another term for the path between two devices on a network. (Remember, a network can mean a heterogeneous WAN comprising many network segments. The bridges connecting these segments can be considered devices on the spanning tree.)

Under the spanning tree algorithm, the bridges making up the alternative routes between New York and L.A. conduct a series of bridge-to-bridge negotiations. The result is that one bridge, the

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one that sees the best path, is in a forwarding state. The other is blocked and won't forward packets. Should the open path degrade, the other bridge will "open" and the first one will "close," thus maintaining optimum traffic rates across the internetwork. This technique is not reserved for long hauls; you can also use it to provide traffic flow management locally or within a campus.

Managing Heterogeneous Networks

If bridges, routers, brouters, and gateways enable heterogeneous networks, today's breed of network management systems validates them. There are several levels on which you can manage the heterogeneous network. On some levels, the very differences that are inherent in different manufacturers' products are a severe hindrance to successful management. However, there are approaches that work, and quite well.

There are three levels of network management. The first level, simple performance monitoring, provides information on data throughput, node failures, and other global occurrences in a rather nonspecific way. Products such as Novell's LANtern and Network General's Watchdog provide some cost-effective ways of "watching" network segments and reporting the existence, if not the cause, of a problem. Such solutions are useful for small to medium-size LANs without a great deal of internetworking. Although they do not provide an abundance of quantitative data, they are relatively low in cost and easy to use.

The second level is network analysis, which adds quantitative information to the monitor's qualitative data. Tools such as Novell's LANalyzer and Network General's Sniffer let you analyze network activity from a wide variety of angles, at a depth that includes packet-level protocol analysis. These systems have the advantage of being precise. They provide a wide array of complete information about the operation of a network. They have the disadvantage of requiring a high degree of knowledge on the part of the operator. They are also often very expensive.

Management Protocols

Widely dispersed heterogeneous networks cry out for better, more comprehensive, and easier-to-use management tools. The solution comes from two directions. First, there is a new breed of global network management systems emerging in the mixed-network market. Second, there are two enabling technologies, in the form of emerging standards, called SNMP and CMIP (see "Dueling Protocols" on page 183).

Even though many manufacturers are producing devices that adhere to one or both of these standards, the standards themselves only dictate a method of communicating network management information. Being able to use that information is only part—albeit an important part—of the heterogeneous networking puzzle.

Management communications protocol allows such products as Cabletron's Remote LANView and Synoptics' LattisNet Network Manager to maintain a view of a global network. Although both systems, and others like them, provide a wealth of detail about the individual manufacturer's products, the information they provide about other network components is less complete. Both systems use SNMP and therefore can communicate with any network device that also uses SNMP, but the degree of usefulness diminishes as they view other vendors' products.

These and other products like them have opened the eyes of network administrators to the possibilities of heterogeneous network management. What is needed in the next generation is a global management system that provides the same depth of information in the same easy-to-use, highly graphical style, without regard to who makes the devices on the network or what management protocol (if any) the devices support.

Cabletron has recently introduced such a product. The new system, dubbed Spectrum, is the vanguard of the next generation of heterogeneous network management tools. It is highly graphical, allowing rapid user interaction and reducing the need for highly skilled network analysts at most levels. It can learn and reason as it isolates network faults. And it has no preference regarding a device's vendor or protocol.

While Spectrum appreciates SNMP or CMIP, it doesn't require either of them. In addition, the depth of information and graphical display power is not affected by the vendor of the device under scrutiny. Spectrum is the premier network management system available today, combining monitoring, analysis, and management of widely dispersed heterogeneous LANs; it points out the future direction of network management.

Cost and Effect

You have to ask yourself whether a heterogeneous system is worth the time and expense. The answer depends on the size of your organization. In large organizations, you probably will not have any choice: The day will come, if it hasn't already, when you will start interconnecting the LANs in your company into one big heterogeneous system. If you haven't started planning, you'd better start now. The more you can adhere to standards and plan for interconnecting network segments on the levels discussed, the easier your job will be when the need arises.

In smaller organizations, you have more options. Companies often don't benefit from internetworking in reasonable proportion to the cost of its implementation. For all sizes of organizations, there are trade-offs when you start connecting, and they will nearly always be to the net benefit of large organizations. There is often more pain than gain for the smaller ones.

For example, although performance across an internetwork is not up to the performance on individual network segments, the benefits of information sharing and communication on a global level are worth the minor performance degradation in a large organization. Small organizations, however, must weigh performance along with increased cost for equipment, increased support and training requirements, and increased management needs when deciding if the "big connection" is for them. Often, less complex and costly methods can be used in place of heterogeneous networks.

There's little doubt that true heterogeneous networks are possible, even desirable, in many cases. Today's tools for connecting and managing mixed networks, along with the proliferation of meaningful network standards, has turned the year of the LAN into the decade of the internetwork. How you should respond depends on your individual needs and your organization's networking culture.

The idea of pulling corporate networking into a single system is nothing new; MIS managers have been doing it for as long as there have been computers. However, the idea of doing it with PCs—those small, powerful, and very personal computers—meets with varying degrees of approval. Eventually, organizations will internetwork. For many, it's a question not of if, but of when. If you stick to standards, plan as you go, and think in global terms, you can make a true heterogeneous network a reality. ■

Peter Stephenson is a writer, lecturer, and consultant on enterprise networking issues based in Rochester Hills, Michigan. He can be contacted on BIX as "pstephenson."



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Unless you want a system manager at each distributed site, you need automated management tools

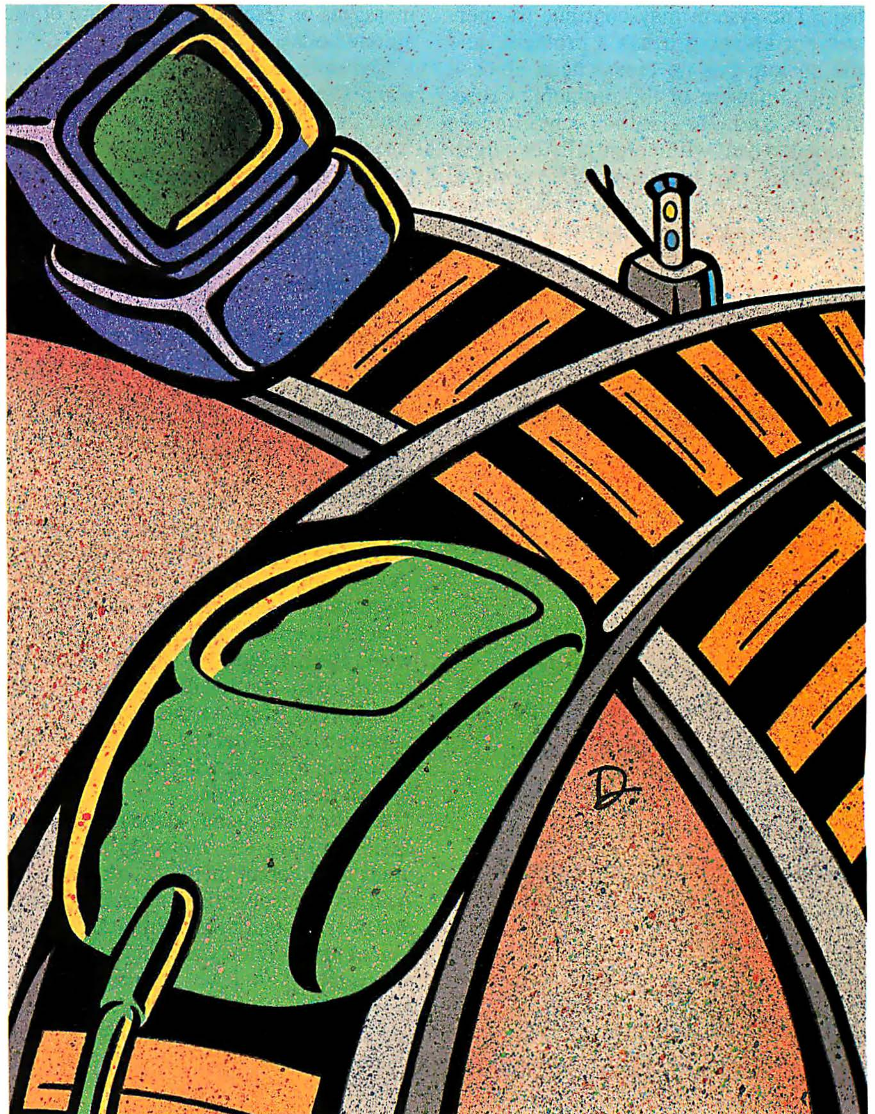
CARL MANSON AND J. SCOTT HAUGDAHL

As networks become vital to the operation of many different types of organizations, one task becomes increasingly difficult and important: ensuring reliable, responsive network services in a dynamic, distributed environment. To complicate matters, the environment, which often intermixes PCs, workstations, LANs, wide-area networks, minicomputers, and mainframes, may have been assembled piecemeal and can include software systems not originally designed for it. Further compounding the task, the distributed environment usually contains offerings from many different vendors.

In a distributed environment, the system plan must be able to evolve as technologies change. It must cover such issues as cable planning and ongoing maintenance, approaches to centralized-version distributed management, growth and capacity planning, the standards supported in the environment, and the commercially available management platforms to be used. With new technologies such as station managers coming onto the scene, you must be constantly aware of new techniques for implementing overall system control.

Technical Issues

Vendors are making great strides in network management offerings. LAN-server operating systems now let you see performance statistics and accounting information. You can remotely control terminal servers and bridges that report traffic conditions and errors. And many vendors are offering add-ons to existing systems—particularly to PC LANs, which have had little or no management



capability in the past.

Network management system vendors are also beginning to agree on standards implementations and interoperability conformance testing. However, efforts to provide compatible management systems are not progressing at the same rate as the technological advances that drive the industry.

To manage a large distributed system that can include mission-critical applications, you need some level of automated network management. The following are important technical issues to consider:

• *Common mode failures*. One critical issue is how a failure in an element common to more than one instance in the network affects the overall operation. For example, if bad data or code (i.e., a software bug) somehow enters the management system topology database, it may also affect a backup management system. The system may continue to operate, not knowing it has a problem, and the backup has no cross-check since it is also unaware of the problem. Cross-checks and consistency checks are needed to deal with potentially bad data.

• *Traffic*. This includes traffic sent and received by the network management system. If multiple failures of network elements occur in a given period of time, the traffic can increase to the point that it affects the real-time requirements of messages passing over the LAN. Likewise, heavy reporting of failures may overload the management system.

• *Robustness*. The LAN management system's reaction to unexpected events or "illegal" messages is important, particularly in mission-critical systems. The system must react properly to duplicate messages or to messages from nodes that are unregistered or known to be down. A robust system continues to function in these circumstances by making correct decisions about unexpected events.

One reaction might be to ignore the situation and let normal protocol mechanisms, such as time-outs and retransmissions, handle the problem. Another approach would be to set a status flag to indicate that system performance is degrading and then send out synchronizing messages or resets to one or more of the system nodes.

• *Centralized or decentralized management*. Centralization of anything usually also implies a central point of failure. Issues to consider for a functionally distributed network management system include consistency (e.g., of databases and network state), synchronization among standby systems, and frequency of database updates.

Another issue is the appropriate destination of status and error information. In some cases, it may be sufficient to maintain information by local group, while in others, the LAN management system at the central control point will have to be involved.

• *Protocol standards*. Standards both facilitate and hinder analysis. For example, if the network management system incorporates standards, additional testing may be necessary to ensure that the system adheres to these standards; otherwise, unexpected data interpretation can result. Also, the selected standards may not directly support the required management functionality, or their use may introduce inefficiencies that can degrade system response time.

On the other hand, standards make it easier to integrate management components with other network components. And as the network continues to grow and evolve, standards permit the integration of new products and technology.

• *Testability*. A LAN management system with built-in test points makes testing easier. Test points consist of interfaces, snapshot facilities, and tracing facilities.

• *Extensibility*. This includes the ability to accommodate traffic growth and to extend the network by adding new nodes or connecting to other networks. It also includes the ability to incorporate new technology easily as opportunities arise. It is conceivable that the network management design could artificially limit network growth.

• *Programmability*. The LAN management system should have a long life span. Its adaptability to system changes depends on its ability to add new features and technology easily, with a minimal impact on the existing system. A simple example is adding new alarms or alerts from applications; a more complex example is attaching an element with a new architecture to the LAN.

• *Inherent reliability*. Reliability largely depends on the amount and complexity of the functions performed, along with the algorithms used. The techniques for carrying out the various network management duties must be analyzed in order to determine the overall integrity of the management system itself.

BYTE ACTION SUMMARY

Managing Distributed Systems

Managing a large distributed system that can include mission-critical applications requires some level of automated network management. There are several important technical issues to consider: common mode failures, traffic, robustness, centralized or decentralized management, protocol standards, testability, extensibility, programmability, and inherent reliability of the LAN management system.

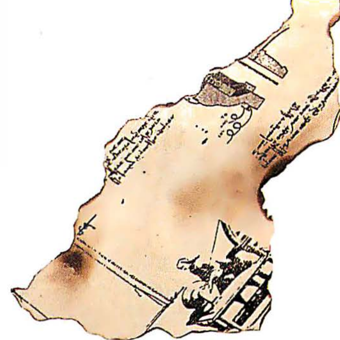
Management Issues

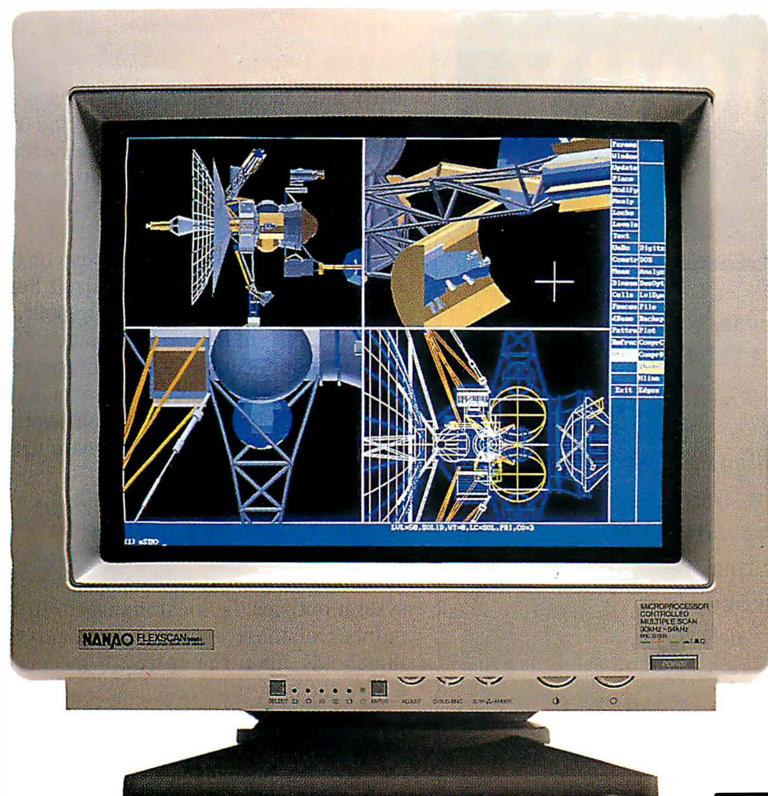
Along with some sticky technical issues, the operation of distributed systems also involves a number of management issues. These include software distribution and version control, error determination and correction, system configuration management, and access control/security.

Software distribution and control are necessary to prevent the introduction of nonlicensed software—as well as viruses—into the network. One way to control software distribution is to handle it from a central location in the network. Software is copied to remote-site file servers from a single distribution point and can then be copied to local disks, if necessary. Using diskless workstations eliminates this potentially troublesome step.

With enterprise-wide applications (e.g., distributed databases), synchronizing system updates to ensure that all users are running the same version of the software becomes an issue. One solution is to always maintain two copies of the application on the local network. At a preset date and time, the "new" version is used instead of the old one. You include this temporal information as part of the download of new software to the local networks.

Unfortunately, the temporal information included with the downloaded software goes on the assumption that all download operations will be completed by that date and time, and this may not be a valid assumption. For example, what if the target file server (or the disk system)





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is full? Any remote system that "misses" the update can cause serious trouble on an organization-wide basis.

An alternative is to send temporal information to all sites only after they all receive the new software. In a sense, this only postpones any problems. Typically, however, the problems that arise from this approach are easier to deal with, because of the relative size of the temporal message versus that of the software itself.

In many applications, such as those in the banking industry, you also have to synchronize remote software versions with central transaction-processing software versions. The simplest way to handle this is to make sure that all transactions include version information and that the central software rejects any out-of-date versions it detects.

In general, this approach is effective, but it can cause widespread distribution of software that contains serious bugs. Often, the software distribution scheme includes keeping two software copies on the local networks so that the system can recover from a newly introduced bug by falling back to the previous version. However, this approach does not protect you from attack by Trojan Horses. With the Trojan Horse, a bug can lie dormant in several successive versions of software and then suddenly surface with potentially disastrous results.

For example, assume that the bug is present in all software versions at the remote sites (i.e., both the current version and any backup versions). Once it surfaces, new software that corrects the problem must be distributed to all sites immediately. This can be quite a problem, depending on the network size. And in an extreme case, the bug could be embedded in the software distribution system software itself and cause it to completely cease functioning. This could crash the entire network.

The Trojan Horse terminology conjures up visions of malicious attacks on the system, and this is a possibility. However, simple programming errors or subtle design flaws can be the culprit. The key point is that the bug remains undetected for a period of time. The extent of the problem can vary widely, depending on where the bug is. It might affect only a small part of one program, or it could have more disastrous results.

Finding and Correcting Problems

Centralized management of a distributed system requires heavily automated network management procedures, error reporting, system backup, and so on. Virtually all successful PC LAN installations to date also include an individual who functions as the system manager.

With small networks, this job is typically a de facto position; one person assumes the position by default and becomes the local expert. In larger systems (upward of 10 nodes), the position is increasingly becoming a recognized job function with specific duties.

Management software that runs on the LAN and reports to a centralized host-based system is one way to augment an on-site LAN manager with automated computer applications that perform some of the manager's functions. The local LAN management software can contain one or more of the following capabilities.

• *Problem determination and recovery.* The LAN management software records problems related to adapters and media. When errors such as collisions occur, the system notifies the local manager. If the number of these errors exceeds certain thresholds, then the software may also notify the host system.

The software may also provide a facility, such as an echo mechanism, to monitor critical resources on the network, such as gateways and file servers, and notify the local manager—and possibly the host manager as well—that a resource has failed. Ethernet networks require such a mechanism since they don't have the automatic error-reporting capability that token-ring networks have.

When there is a problem, typically the LAN manager is alerted with an audible alarm and a highlighted indication of the problem on the display. In addition, the software may attempt to identify the problem, stating the probable cause and including the information needed to isolate it and recommendations for actions to take to resolve it.

This information could also be forwarded to the host console. The central site may use it to alert a remote site that a problem exists. The central site can also use it to maintain a centralized problem history file for each remote LAN. The log can contain vendor contacts for specific problems, generate trouble tickets, include information about how the problem was resolved, and so on.

• *Event logging and report generation.* Network events, such as peak network utilization times, new network addresses observed on the network, and error conditions, can be logged to a disk file or a printer.

Token-ring networks have many automatic error-reporting functions built into the adapters. These errors and changes to the token ring, such as stations entering or leaving the network, are reported via media access control frames that the ap-

propriate LAN management software can interpret.

Typically, you can generate reports from the information stored in the event log over a selected period of time; for example, a network manager may want to review network utilization for the past 24 hours.

• *Operator control functions.* The LAN manager may want to query the status of any device attached to the network, such as a workstation, bridge, or gateway. For example, token-ring adapters maintain a history of error statistics and other information, such as product instance ID. Also, bridges usually keep statistics on traffic passed through and error counts.

Bridges are an interesting case. Standards such as SNMP are emerging and are finding their way into bridges and other devices. With the proper software, the LAN manager can query these bridge statistics using SNMP.

Another useful function tests the status of the path between two workstations. This is especially handy when repeaters or bridges separate the workstations.

Configuration Management

Configuration management requires knowing what software is installed on what systems. For internally developed applications distributed automatically and subject to strict version control, this is usually not a problem. But for end-user software (e.g., spreadsheets and word processors), keeping track may not be easy.

The approach that large corporations with PC LANs most frequently use is to have a group of supported software packages available on the network. Typically, the list includes one or two fully featured packages in each of the standard PC software areas (e.g., word processing, database, spreadsheet, and telecommunications).

If you use these packages, you receive support from the company's technical-support personnel in the form of question answering and problem solving, tutorials and training, and data conversion utilities. If you prefer to use other packages to accomplish the same basic functions, you can, but you do it at your own risk—no technical support is provided. This approach doesn't prevent you from using nonstandard software, but it does discourage the practice.

Establishing a supported list of applications provides a framework within which to evaluate nonstandard exceptions on a uniform, case-by-case basis. It also provides management and support advantages over a free-for-all approach. Version control, problem solving, training, and, eventually, migration to new packages can all take place in an orderly, well-defined manner.

Another concern is how the software on a particular machine is configured internally. Most popular PC software packages support a variety of internal configuration options, ranging from screen colors to printer-control codes and default disk directories. With experience, you can easily change these internal configuration parameters to suit individual tastes.

These parameters typically become an issue when you need technical support to diagnose and solve problems. Many internal parameters, such as choice of screen color, are probably not worth worrying about in terms of a central management strategy. Others, such as what printer-control codes you are using, can be important in the context of problem diagnosis and solution.

For externally developed packages, it is essentially impossible to prevent you from changing your internal configuration for a particular package, so the next best thing is to have a prescribed standard configuration for each supported program. In the worst case, technical-support personnel can return your implementation to the standard configuration as the first step in determining and correcting a problem.

Another key point to consider is where on the network to store end-user applications. Usually, you store such code only on the server, where the various workstations can share it. This approach simplifies management problems, if only because it decreases the number of copies of the software in the system by a factor of about 20. This is also how network-licensed packages operate.

One approach to managing a workstation's programs and configuration is to have a "scrubber" program that runs automatically in each one. The scrubber might run periodically, or as part of a system-initialization process that occurs frequently (e.g., entering the main system menu).

The scrubber has a list of executable files, configuration files, and subdirectories sanctioned by the system, and it scans your hard disk, discarding files and directories that do not appear on its list. This approach is somewhat heavy-handed, and if you are determined and diligent, you can defeat it. Most users, however, won't find it worth the effort to continually battle against a scrubber.

Access Control and Security

There are two components to controlling access to the network. Access has to be

limited both to the local network and, in the case of a geographically dispersed system, to the global transaction-processing network. Generally, you gain access to the local network and the applications that are residing on it. In a completely distributed environment, the applications then gain access to the global transaction-processing network. Often, a centrally maintained directory of valid users is used to control system access.

Application access to the global network can be controlled by password and session encryption features, where passwords are shared between the host-based portion of the application and the workstation-based portion. Thus, whoever gains access to the applications gains access to the global network.

In a simple scenario, passwords might be changed from version to version of the application; in itself, however, this security measure is insufficient to secure the network. You have to use this kind of scheme with measures that control access to the applications themselves. Since the user portion of applications in a client-server-type system resides on the remote networks, the first step might be to control access to these systems.

If it is hard to control access to the applications, security and access controls must be present in the applications themselves. The applications should support user ID and password log-in procedures, where the password is checked against the centrally maintained directory.

Since, for ease of use, it's best that each user have one password, the central directory should contain capability information for each one. Thus, you might have the capability to run application A but not application B. Each application would check your capability to execute it as part of its initialization sequence.

Further refinements of this scheme are possible. For example, the capability for a particular application might not be expressed as a binary value (i.e., you can or cannot run the application), but as a structured value that indicates a level of capability within the application (e.g., you can use some functions but not others; you can read data but not change it).

There are two components to controlling access to the network.

Another area of interest and concern relates to "foreign" software. If a network workstation has a floppy disk installed, it is virtually impossible to control what software you boot on the workstation. Many large corporate LAN installations have used diskless workstations to overcome this problem.

A diskless workstation boots over the network from the file server rather than from a local storage device. The choice of boot options made available to you from the file server can effectively control the software you execute in your workstation. The lack of floppy disk drives also prevents the installation of new software and the removal of network data from the premises.

Who's in Charge Here?

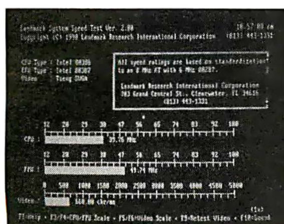
Managing distributed systems in general and doing it from a centralized location in particular are major problem areas. Tools to do this effectively and completely do not exist, but unless you want to have a system manager at each site, you need automated management tools. Efforts to develop customized, centralized management solutions are needed.

Managing distributed mission-critical systems often becomes a critical operational part of the network. Although a lot of the traditional concepts of network management (e.g., fault, configuration, performance, accounting, planning, security, and applications management) certainly apply to such systems, there are additional considerations. These include technical issues, such as common mode failures and the management system's inherent reliability. ■

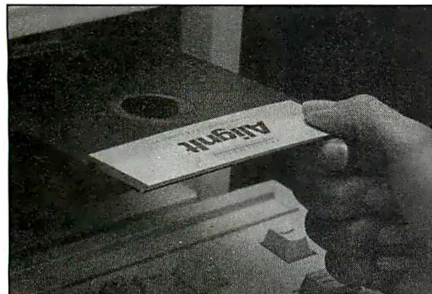
Carl Manson is a senior systems engineer with the communications consulting firm Architecture Technology Corp. in Minneapolis, Minnesota. J. Scott Haugdahl is a senior technical consultant at Architecture Technology Corp. They can be contacted on BIX c/o "editors."

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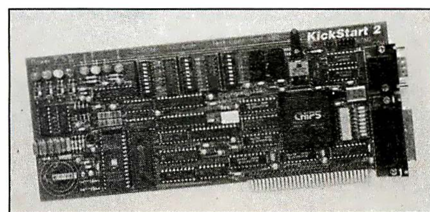
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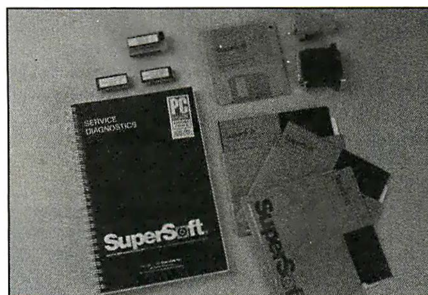
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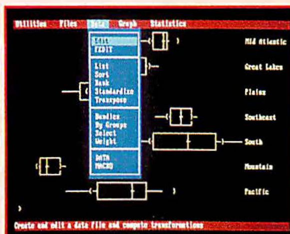


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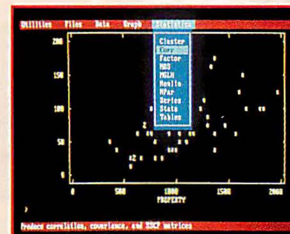


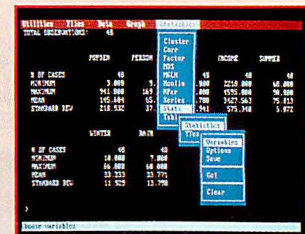


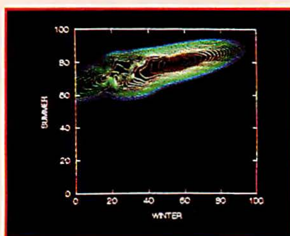
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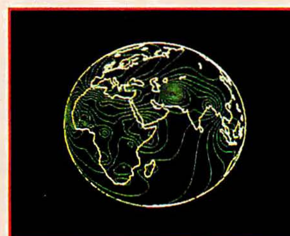


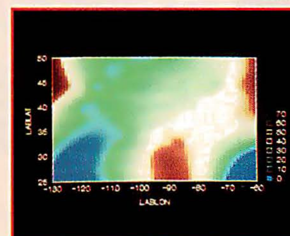


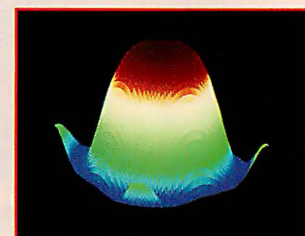












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CONTROL CENTRAL

Tools, techniques, and advice for managing centralized LAN-based services

JEFFREY SLOMAN

The typical PC LAN of a few years ago consisted of a file-and-print-er server connected to a group of workstations. That picture is rapidly changing. LANs today can provide centralized communications, fax, and database services and support a wider range of distributed applications. The LAN is becoming the MIS data center of the 1990s.

The increasingly complex task of managing LAN-based services often falls to ad hoc administrators who acquire their skills on the fly, learning to deal with new demands as they arise. As enterprisewide LANs materialize, that approach won't remain viable. It's critical that organizations protect themselves from uncontrolled organic growth.

I will offer some advice, drawn from my own experience, concerning common pitfalls and the methods and tools that can help solve them. My examples are DOS/Windows/NetWare-oriented, since that's my specialty, but the principles apply equally to other kinds of networks.

Integrating Central Services

As your needs demand more services, they must be provided in ways that do not compromise existing ones. Unfortunately, when you add a new service, it may interact with the LAN in unforeseen ways. Take a look, for example, at adding an asynchronous communications server to an existing LAN.

Fresh Technology's Modem Assist is one solution to the problem of how to share a pool of modems on a network. It works in conjunction with a smart communications adapter, such as Arnet's Multiport/8 serial card. In principle, the

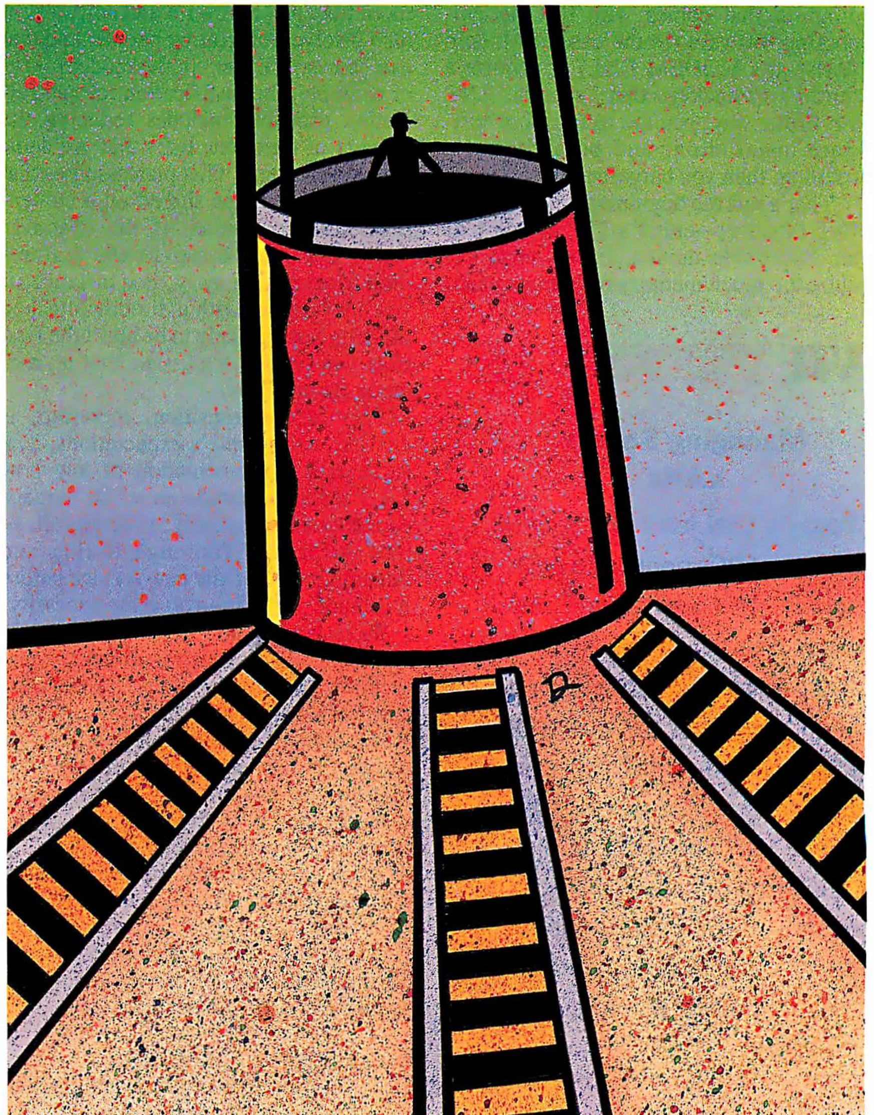


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process is straightforward: You just add a dedicated modem server to the LAN. But, as is typical of centralized LAN services, you have to make changes at the workstations, too. Modem Assist requires an INT 14 driver on the workstation, which redirects interrupt 14 calls across the network (INT 14 is the BIOS communications hook).

Most communications programs don't use INT 14; they write directly to the hardware. So, to use the modem pool, you have to acquire and install a program that communicates with an INT 14 interface. Hopefully, your existing communications program is available in a version that supports INT 14. DynaComm, Reflection, Procomm Plus Network Version, Crosstalk Mk.4, and CoSession LAN are programs that support INT 14.

If your communications program does not support INT 14, you will have to use the INT 14-oriented communications program that comes with the modem-pooling software (in the case of Modem Assist, it's MODEM.EXE) or acquire a third-party package that "speaks" INT 14. Either way, you are in for more software installation, and possibly more training, than you bargained for.

That's just the beginning, though. The INT 14 driver—either a TSR program or an installable device driver—may require too much memory or interact nastily with other TSRs that are in use at the workstation. If you rely on DOS-based multitaskers, such as Desqview and Windows, things can become even stickier. At present, these environments aren't always able to use DOS communications drivers reliably. A solution that saves money, but takes away Desqview's or Windows' ability to download files in the background, really isn't a solution at all.

The term *central service* belies the true complexity of the issue. While resources may be centralized either in the file server or in a workstation dedicated to providing a service, the infrastructure that grants access to central resources is distributed throughout the network. Managing that infrastructure can consume far more time and effort than managing the central services themselves.

BYTE ACTION SUMMARY

Managing Server LANs

Today's LAN isn't just a collection of PCs hooked to a file server. As corporations rely more heavily on LANs, they must learn to integrate new central services smoothly. Installing, configuring, and testing hardware is a big part of the job, but success also depends on training adequately and managing expectations well. Look for tools that automate some of the drudgery.

Power to the People

Integrating central services involves more than just hardware and software; it also involves integrating people, and that can be even trickier. In the modem server example, the justification for centralization probably includes reducing the number of telephone lines that are dedicated to modems. That plan assumes that phone lines will be shared on a contention basis—*contention* is the operative word. It's much easier to add features than to take them away. For instance, if you are familiar with a directly attached modem, you're likely to be upset the first time you receive a message that no modems are available.

Part of the transition, therefore, is dealing with people's expectations. The successful implementation of any new LAN feature depends on it. To manage expectations effectively, you must eliminate surprises. Thorough testing and documentation of any new service before it is made public is an absolute necessity.

Being trained how to use new services is important. Although it often happens, skipping the training step is a big mistake. No matter how smoothly the service is integrated, how reliable the hardware is, or how straightforward the software is, you must modify your behavior to some degree. Without training, resistance to new additions can be great.

Some organizations implement a simple policy: "no training, no service." In other words, you must demonstrate proficiency with a new service before you're allowed to use it. This is a good policy to implement if it's practical for you.

Managing the Applications

Installing and configuring applications software is another integration task that can cause endless grief. Software vendors have only just begun to address the LAN market. Programs usually operate in the LAN environment—in some cases, they are aware of the LAN; in others, they are not—and may even provide some information on network installation.

But if you're concerned with central management, security, and data integrity, the situation is far from ideal. As applications become more complex, so does their administration. Unfortunately, the lack of standard ways in which to design, install, and configure LAN-based applications makes working with each one a new adventure.

What files belong where? It's an obvious question, yet one that even LAN-oriented applications often don't adequately answer. Obviously, the executable file should go in a shared location. That might not involve just one file, however. There may be one or more supplementary overlays, the existence of which isn't always documented. Discovering all the executable components can itself be a trial-and-error affair.

Applications rely on one or more configuration files, the names and purposes of which, again, may not be documented. Generally, these should be distributed to private directories so that the shared program can adapt to individual preferences. But some configuration data may need to be public, too.

In the case of the modem server, for example, you don't need to maintain a copy of the list of installed modems and their associated settings at each workstation. Sorting out which configuration data should be private and which should be public can be a vexing task. Some programs are quite secretive about where and how they store and search for configuration data.

Still, it's worth the trouble to ferret these things out. When you add a new high-speed modem to the network, it's easier to update a shared configuration file than to distribute a new configuration file and verify that everyone receives it and installs it correctly.

Software that provides for device independence, such as Microsoft Windows and many CAD programs, adds another layer of complexity. These programs rely on drivers that adapt the software to particular hardware configurations. If you need to be able to log in at more than one physical location, a tricky coordination problem can result: trying to preserve each user's identity, as well as each machine's identity.

One solution involves a menu front end to the log-in procedure that prompts you

to specify aspects of your hardware configuration: for example, VGA versus Super VGA. This is a poor technique, though, since a wrong choice can crash your system. It's better to record aspects of the machine configuration in DOS environment variables and then use batch files to select appropriate initialization files. In the DOS LAN environment, creative use of batch files is a requirement for effective administration.

The Windows Connection

Windows has been both a blessing and a curse in network administration. Windows' consistent environment can greatly simplify training and technical support. The powerful memory management features of Windows 3.0 allow you to bypass limitations imposed by DOS (if you have the proper hardware). The available applications enlarge the scope and power of desktop computing. However, although Windows 3.0 provides more network support than any previous version, its focus is on simplifying access to network resources, not on expanding the ability to manage Windows and its applications on the LAN.

Ordinarily, a LAN administrator relies heavily on DOS-based menu systems that advertise available LAN services, and on batch files that launch and control the programs that provide those services. Under Windows 2.11, the usual practice was to provide menus that would invoke Windows applications. But with Windows 3.0's new ability to multitask DOS sessions and the availability of more (and more powerful) Windows 3.0 applications, many users want to work exclusively within Windows.

Enter a new class of utility designed to facilitate integration. Windows Workstation from Automated Design Systems gives back the tools Windows 3.0 takes away. With a graphical menu system, a batch language, and a vastly improved print manager, Windows Workstation makes Windows 3.0 more manageable on a network than off. It's available for NetWare and Microsoft's LAN Manager; the latter version ships with LAN Manager 2.0.

The menu system provided with Windows Workstation is, of course, a Windows 3.0 application. That makes it familiar to Windows users. To specify options on a menu, you fill in a simple form, which in turn generates a script, or, if necessary, you write your own script in Automated Design Systems' MultiSet script language. MultiSet looks a lot like DOS batch language, but it adds Windows- and NetWare-specific features. The variable %LOGIN_NAME, for example, returns your log-in name.

Even better, you can use MultiSet to insert user-specific entries into the Windows 3.0 configuration file, WIN.INI. For example, PageMaker uses an entry that looks like this:

```
[PageMaker]
Defaults=c:\pm\pm.cnf
```

You would probably want PageMaker to fetch its settings from the network rather than from the local hard disk. That way, some problems could be resolved over the telephone by running PageMaker at your workstation using those settings. Hard-coding a network path in WIN.INI doesn't separate the machine's configuration from individual preferences.

Daily backup does not always protect critical data.

You can use MultiSet to create a PageMaker-launching menu entry that can tweak WIN.INI so that PageMaker will find PM.CNF in a public directory whose name is qualified by the %LOGIN_NAME variable. Of course, everyone may not need a PM.CNF file. It might make sense to identify groups of users who share similar configurations—say, Art and Production departments—and use the script language to direct individuals to the appropriate configuration file by group.

Dealing with the Data

Backing up the file server remains a vital responsibility. Until recently, this has been a thankless, labor-intensive job. Worse yet, even the most vigilant regime—daily backup—does not always protect critical data. Files can change several times a day, and each version may represent hours of work. If the system fails, the files you want most—the "working set" of files in active use—will be the very ones that yesterday's backup can't restore.

In addition, the usual method for ensuring backup integrity entails tape rotation. If you use multiple tapes in rotation—one a day, usually—you can maintain a history of versions and guard against the loss of a tape (or damage to a tape). But how do you keep track of the tapes? Maintaining a catalog and documenting what's stored on each tape requires a lot of work. Moreover, a simple rotation scheme doesn't account for the need to archive particular files (i.e., storing special "frozen" versions of files on a separate archive tape).

What you really need are tools that can automate the backup chore. Several vendors provide automated data management systems. ARCserve, from Cheyenne Software, runs as a value-added process or NetWare loadable module in a NetWare file server. Full or incremental backups can be performed interactively, or you can use NetWare's queuing services to schedule and dispatch unattended backups. The VAP/NLM implementation makes server backup a quick process: Files move directly from the server to the attached storage device, generating no network traffic. Jobs can be queued on a one-time-only basis or scheduled to repeat at regular intervals.

The VAP or NLM running in the server can also communicate with a TSR program running on a DOS workstation. That eliminates the need for a two-stage backup procedure: first from workstation to server, and then from server to secondary storage. Instead, workstation backups can be scheduled the same way server backups are. At the appointed hour, the VAP or NLM makes contact with the TSR in the workstation and moves the specified set of files through the network and straight onto tape.

You can also schedule unattended workstation backups or perform attended backups, so there's no need for locally attached tape drives. A single backup device can serve the whole LAN—although, as with the modem pool, it's on a first-come, first-served basis.

ARCserve also does a good job of logging each tape session. The administrator can see the whole log; users see only their own backup jobs. The beauty of ARCserve is that it overcomes human inertia. Once repetitive workstation and server backups have been scheduled, everything's automatic—almost. Someone still has to pop in a new tape every day, if you're using a tape rotation system.

Storage Dimensions (San Jose, CA) makes innovative use of ARCserve. Bundled with the company's LaserStor erasable optical disk drive, ARCserve works

the same as it does when it's used in conjunction with tape storage. In this case, however, Storage Dimensions' drive provides fast, random access to the archived data. This combination protects against not only data loss, but also drive failure.

The LaserStor, being a direct-access device, can be used as an emergency replacement for the server's hard disk drive. It's slower than a fast hard disk drive, so it's not a full-time replacement for your ESDI or SCSI drive. But the ability to restore the network by switching to a 1-gigabyte optical backup device is an intriguing form of fault tolerance.

Smart Storage

By combining features such as those in ARCserve with a rule-based expert system, Palindrome's The Network Archivist represents a forward-looking approach to automatic data management. Palindrome has structured TNA's functions into four groups, which are described below.

• *Backup.* TNA's backup function relies on "checkpoints" that resemble traditional incremental backups, but with a twist. For each file, you can specify that it be written to tape always, never, or—crucially—only when changed.

• *Archiving.* An archive, called a "save" by Palindrome, is a permanent copy of a stable file. TNA defaults to six weeks without change as an indicator of stability, although you can tweak this parameter on a per-file basis. TNA will make sure that the file is written to at least three different tapes in the tape rotation before considering it protected.

• *Restoration.* The ease of recovering a file's previous versions is one of TNA's most powerful features. You find the directory on a graphical tree, select the file from a list, press Enter, and choose the version you want. The checkpoint history is kept in an on-line database and tracked across tapes.

A catalogue of this type is essential if a backup system is to be useful for anything short of disaster recovery. TNA can also restore entire volumes. When it does, it uses its database to avoid restoring files that were intentionally deleted prior to the last checkpoint.

• *File-system maintenance.* TNA's most compelling feature is the automatic migration of unused files to tape. This "pruning" ability works by monitoring file access dates. Using rules defined by the LAN administrator, TNA determines when to move files from primary storage (i.e., the server's disk) to secondary storage. This can occur automatically, or it can require TNA to prompt for confirmation.

A "phantom file" can also be left in place. A phantom file has zero length and carries the name of the migrated file. A TSR is loaded on the workstation. When you try to access such a file, the TSR pops up, explains that the file has migrated to secondary storage, and advises you to ask the LAN administrator to restore it.

The future of products like TNA is bright. One interesting prospect entails the use of a three-tiered storage system consisting of a primary magnetic disk, a secondary optical disk, and a tertiary tape drive. In this scenario, static files migrate from primary to secondary storage, and, if untouched for some additional period of time, they migrate from secondary to tertiary storage.

The future of products like Palindrome's TNA is bright.

Ideally, you would be able to access files in secondary or tertiary storage as easily as you now can access files in primary storage. The only difference would be an occasional message announcing a delay while the system activates an archived file.

Managing the Configuration

Traditional methods of backup and archiving don't address the need to preserve the work that has been done to configure the network operating system itself. Although any good backup program will save the network's system files (or the "bindery," in NetWare lingo) to tape, products like Cheyenne's NetBack save the logical configuration of the network in a form that allows for its reuse.

NetBack interprets the data that is stored in the bindery files and stores it as a description in what Cheyenne calls a "vault." The information is now more useful than a literal copy of the NetWare bindery. While it can be used to restore a server, it can also be used to add a new server to a network, endowing the network with the same configuration of users, groups, print services, log-in scripts, and security.

Programs like NetBack represent a welcome trend. Vendors of network operating systems have, understandably, concentrated on the operating systems themselves. Auxiliary network administration tools are typically weak. This has exacerbated the tendency to ignore key maintenance tasks.

Several vendors offer integrated utility packages designed to assist in network administration. Products like Fresh Utilities for NetWare from Fresh Technology Group and Cheyenne Utilities for NetWare from Cheyenne Software provide a number of programs aimed at managing the logical and physical configuration of the network and its servers.

One of the principal tools for managing the network is documentation. A record of each user's access rights, log-in script, group membership, and other pertinent data, along with a hardware configuration inventory, can save countless worker-hours in troubleshooting and disaster recovery.

As a manual process, compiling such documentation can be an overwhelming task. It's another example of something that ought to be done but is put off for lack of time. Once again, automation is the solution. Both of the products mentioned above produce extensive network configuration reports drawn from direct examination of the live network.

As the quantity of data grows and the number of services multiplies, it becomes harder and harder to manage a LAN manually. Products such as Palindrome's TNA herald an era of automated LAN management based on expert systems and AI techniques. The transparent operation of future network management systems will free you to work smarter and to focus on the what, rather than the how, of LAN administration.

The PC world in general is on the verge of maturing into what the mainframe world has become. Demands for better management, fault tolerance, and security, driven by a trend toward downsizing from mainframes and minicomputers, will help to fuel the development of the tools and methodologies for managing tomorrow's LANs. ■

Jeffrey Sloman is vice president of technical services for Systems Integration, Inc., an Indianapolis-based consulting firm. You can contact him on BIX as "jsloman."

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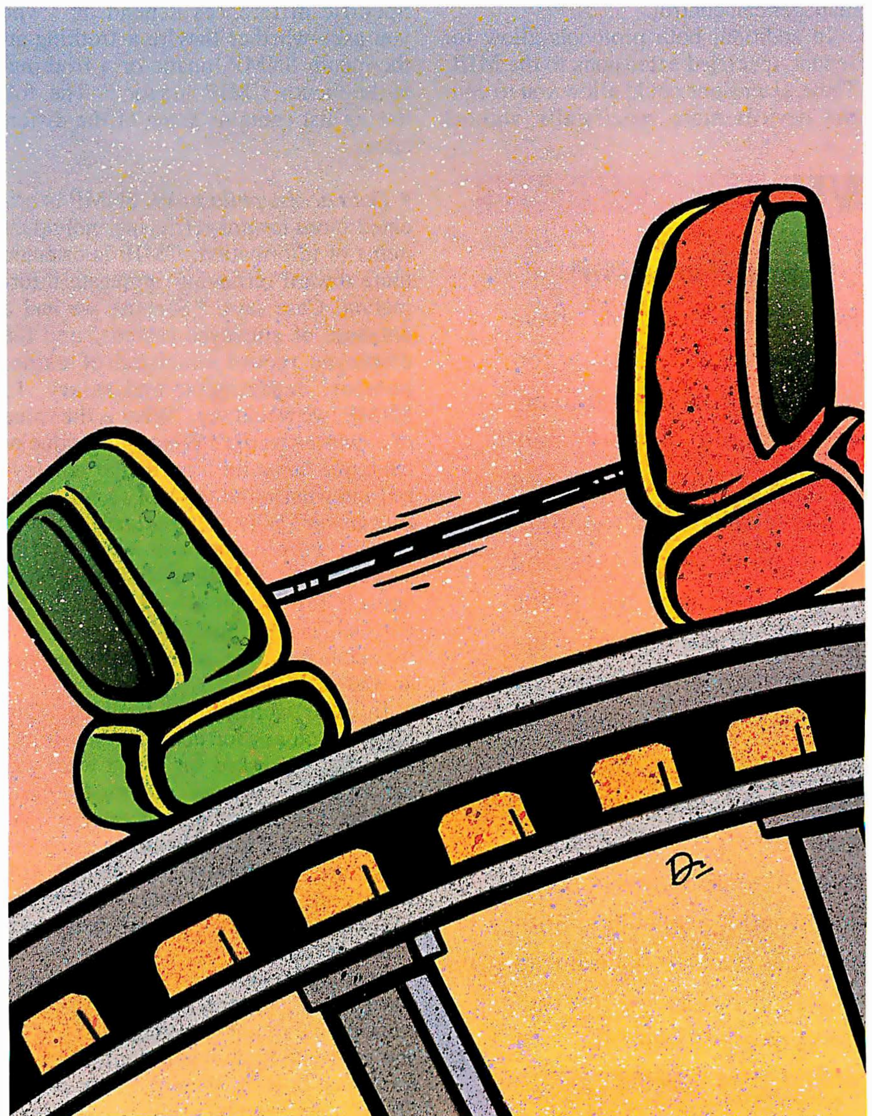
SHARON FISHER

One of the hottest topics in networking today is network management. Now that most of the connectivity and interoperability issues have been or are being resolved, you can turn your attention to keeping track of the devices on your networks, checking on the network's performance and load, and diagnosing and correcting any problems.

While products that manage homogeneous networks have been available, managing heterogeneous networks is more complex. Some people fear that if you depend on one vendor's proprietary solution to manage your network, that vendor could try to steer the blame for any problems toward third-party products.

Therefore, much of the attention in managing heterogeneous networks has focused on two families of network management protocols: the simple network management protocol (SNMP), which comes from a de facto standards-based background of TCP/IP communication, and the common management information protocol (CMIP), which derives from a de jure standards-based background associated with the Open Systems Interconnection (OSI).

Until fairly recently, debates comparing the two sets of protocols have raged in conferences, electronic discussion groups, and scholarly papers. Now, however, proponents of both sides are beginning to admit that *both* protocol families have a role to play in managing the networks of the future. And discussions are currently moving toward trying to figure out which duties each protocol family is best suited for. *continued*



Similarities

In many ways, SNMP and CMIP are more similar than they are different—a view that even die-hard proponents of one or the other admit. "They're similar in that both have the same goal: to move network management information from one place to another, so the network manager can retrieve information from a device, make changes, and find out what's broken," says Jeff Case, one of the authors of SNMP and president of SNMP Research (Knoxville, TN), a company that supplies core software to SNMP vendors. "For problem diagnosis, for capacity planning, for report generation—both would be useful in that regard."

Both protocol families use the concept of a management information base. A MIB consists of a set of variables, test points, and controls that all devices on the network support and that a network manager can control.

In addition, both protocols allow for vendor-specified extensions to the MIB. These extensions could allow you to control devices more specifically without requiring that you use a least-common-denominator approach to network management. They could also enable the management of heterogeneous networks.

In some cases, SNMP proponents have bowed to CMIP and taken advantage of ways in which the CMIP specifications are superior. For example, vendors are making the SNMP MIBs and extensions to them compatible with those that are used by CMIP. In addition, the content and structure of SNMP packets are defined using the abstract syntax notation (ASN.1) OSI-standard protocols.

Differences

The differences between SNMP and CMIP are also present in a number of areas, and they often end up being as much a matter of "religion" as anything else. "The differences between SNMP and CMIP are in the category of differences between C and Ada," Case says. Specific differences depend on "who you ask—whether they're a frothing-at-the-mouth SNMP lunatic or a frothing-at-the-mouth CMIP lunatic." The following list contains some of the differences.

• *Data access philosophy*. SNMP is oriented more toward retrieving individual items of information; CMIP is oriented more toward retrieving aggregate information, Case says. "Suppose we had a database of employee records, and the employee record consisted of name, number, department, and salary. In SNMP, we would say, 'What is the value of *employee record*? What is the value of *employee name* for a particular employee, and what is the value of *social security number*? What is the *salary* for a particular employee, and what is the *department*?' SNMP would say, 'The value of this field is *this* and the value of that field is *that*.' In CMIP, we say, 'Tell me about *employee*, such that *employee* is so-and-so.' "

In other words, Case continues, "in SNMP, you ask for just what you want, and what you asked for is just what you get. In CMIP, you say 'give me the class of what I want, subject to certain constraints,' and it gives you everything except what you threw out. In SNMP, you ask for and receive answers to more focused questions, where CMIP deals with data more in bulk."

Both approaches have their advantages, Case points out. "It depends on what problem you're trying to solve. If you're trying to deal with individual information objects, then you want to use SNMP. Suppose that I wanted to find out about a particular individual's salary. The CMIP approach is to get the whole database and throw out everything you don't want. It's not terribly efficient. But if you want the whole [database], then CMIP is going to be better."

• *Polling versus reporting*. Similarly, SNMP works by *polling*, or regularly asking each device for its status, while CMIP uses *reporting*, or having the device inform the manager of its status when it changes. "SNMP polls devices to find out if they're dead or alive, while CMIP relies on the device itself to communicate to the management system that something has happened," says David Mahler, formerly responsible for marketing activities for OpenView (a network management product from Hewlett-Packard) and now vice president of marketing for Remedy (a start-up company in Palo Alto, CA, developing protocol-independent network management products).

CMIP's approach has both advantages and disadvantages. "If you have a large number of devices that you're polling all the time, you can consume net bandwidth [with SNMP]," Mahler points out.

For example, the SNMP demonstration at the 1990 Interop (see the text box "The Field of Battle" on page 186) featured an admittedly unusual 26 network management devices, each doing its own polling. These took up some 15 percent to 20 percent of the Ethernet show network, according to Rich Fitzgerald, the western region support manager for Xyplex (Boxboro, MA) who helped to arrange the demonstration.

In general, the whole issue of what percentage of the network the load management should be allowed to take up is unresolved. Many people in the networking community are concerned about it. However, with SNMP's philosophy, "you can have stupid devices that don't have to be smart enough to tell you they have problems," says Mahler. This, combined with SNMP's smaller size requirements, makes it more useful for smaller devices such as PCs.

• *Functionality*. CMIP is generally thought of as having more specific features and capabilities. But, notes Case, they may well be capabilities that you neither want nor need.

"For example, take the ability to move a table of 10,000 information items from one location to another. CMIP will do that better. But an SNMP person says, 'Why would I want to move a table of 10,000 items? All I want to do is scan the

BYTE ACTION SUMMARY

SNMP vs. CMIP

Both SNMP and CMIP have the same goal: to move information from one place to another so the network manager can find out what's broken. Both use management information bases and vendor-specified extensions to MIBs. The differences between the two lie in data access philosophy, polling versus reporting techniques, functionality, size and performance, type of transport layer, standards and testing, and product availability. Both protocol families have a role to play in managing the networks of the future.

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The Field of Battle

Many of the milestones associated with the SNMP-CMIP debate have occurred at Interop, an annual exhibition and technical conference dedicated to helping people set up and manage heterogeneous networks. In 1987, discussion began on developing SNMP based on the earlier, less complex SGMP, while CMIP was still being defined.

User organizations, in general, were interested in getting products with which to manage their already burgeoning networks. Vendors, in general, were hoping to have to develop only one family of network management products rather than two, since even SNMP proponents conceded CMIP would probably be the final result.

Then, at the 1988 Interop, competing panels of SNMP and CMIP vendors each insisted that their protocol was superior and that future Interop conferences would demonstrate that. At the same time, the Internet Activities Board, which acted as a governing body for the TCP/IP networking community and provided some measure of control over the de facto standard protocols, was debating which of the protocols it should approve. The eventual result was that both were approved: SNMP for the present, and CMIP as a future goal.

CMIP proponents were far less in evidence at the 1989 show. Only a couple of vendors demonstrated products, while numerous SNMP products were shown. Then, at the 1990 show, SNMP exploded: Nearly 50 companies took part in a demonstration referred to as the SNMP Solutions Showcase. Again, only a few CMIP products were shown.

---

table and ask for the things I wanted in the first place.' "

Karen Auerbach, president of Epilogue Technology (Ventura, CA), agrees. She points out that while CMIP may have more capabilities built in, most of them can be accomplished elegantly with SNMP if you're familiar with the protocol.

• *Size and performance.* Case says that "SNMP is going to tend to be smaller, faster, and less expensive than a CMIP implementation. CMIP will require more processor capacity, run slower, require more memory, and be more expensive." This also relates to the polling versus reporting issue, because polling requires less intelligence from the devices being managed than reporting does.

For example, in most cases, vendors can implement SNMP in a pop-up TSR program on an MS-DOS PC, Case says. "You can't do that with CMIP. Of course, if you buy extended memory and a big extended memory board, sure, someone can come up with a counterexample and make a liar out of me."

SNMP's simplicity also gives devices "more bang for the buck" in terms of CPU load, Case says. A standard measure of CPU use in network management is "management operations per second," or MOPS, a similar measure to millions of instructions per second (MIPS) and floating-point operations per second (FLOPS). "You'll get a lot more MOPS out of SNMP than out of CMIP."

Because of SNMP's smaller size, it has even been implemented in such devices as toasters, compact disc players, and battery-operated barking dogs. At the 1990 Interop show, John Romkey, vice president of engineering for Epilogue, demonstrated that through an SNMP program running on a PC, you could control a standard toaster through a network.

Similarly, Simon Hackett, of the University of Adelaide in Australia, working with TGV (Santa Cruz, CA), demonstrated a CD player with an X Window System interface through which you could select discs from a library, choose which songs to play, and adjust the volume. And you could perform all these functions over a network, as TGV staffers learned one evening when a bored Hackett cranked the volume to 11 in the Santa Cruz offices from his computer in Australia.

At the same Interop conference, Case used a battery-operated barking dog to demonstrate how two SNMP network managers could control the same device. Playing on one of Case's signature expressions, "That dog won't hunt," the dog would walk and yap when directed to by either program, but would return an error message if the two programs tried to control it simultaneously.

Although these demonstrations were just for fun, they pointed out how SNMP could be applied to noncomputer devices as well. Hackett's CD player was connected to the network through a "black box" he built with 64K bytes of RAM. Several people asked to buy copies of the box since it wasn't specific to the CD player. He and Romkey joked about designing a "home-appliances MIB" that, all kidding aside, could be implemented to automate any number of devices.

• *Transport layers.* For its underlying transport mechanism, which is what transmits data between nodes on a network, SNMP requires only "unreliable datagrams," which means it can be used with Ethernet, Novell's IPX, UDP, and other simple communications protocols. CMIP, in comparison, requires a reliable transport layer, such as TCP/IP or OSI's connection-oriented TP-4 transport protocol.

While this sounds shaky, "unreliable" in this case means only that the data is sent with no guarantee of delivery. If the receiving device doesn't acknowledge that it's gotten the data, the sending device simply transmits the message again.

The usual analogy for unreliable versus reliable is a letter versus a phone call. The phone call sets up a circuit between the communicating nodes, while the letter is simply sent. On the other hand, letters require less equipment and overhead than do phone calls. What's true for the letter is also true for unreliable datagram transport.

While the reliable transport layer makes CMIP better at retrieving large amounts of data, it may also make the network harder to manage when trouble occurs. And that is when managers need network management the most, Case says. "Say that the network is in a fault state. Use of unreliable transport allows the network management station to retry until it gets through. A connection-oriented network tends not to be able to deal with that, and it may not even be able to get a connection in the first place."

In other words, Case explains, when troubles occur, "you want network management to run on an all-terrain vehicle. You don't want a more fragile vehicle—[the messages] have got to get through."

• *Standards and testing.* CMIP, like other OSI protocols, is an international

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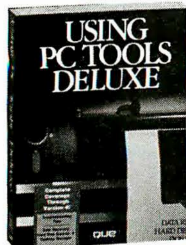
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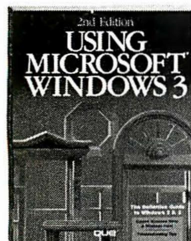
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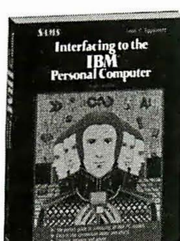
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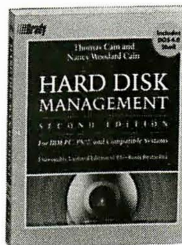
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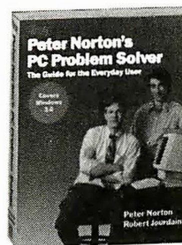
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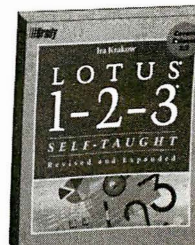
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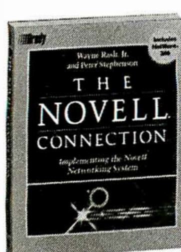
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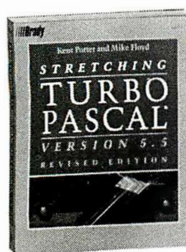
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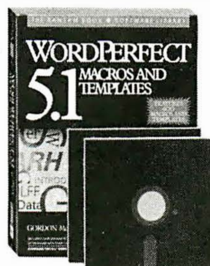
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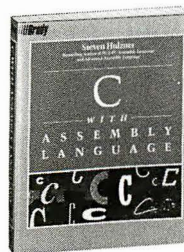
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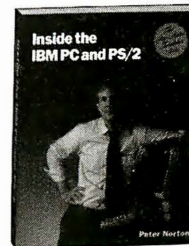
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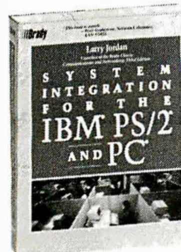
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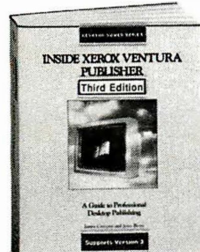
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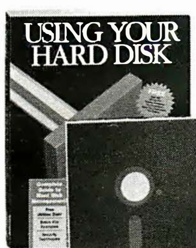
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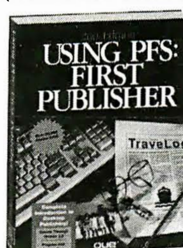
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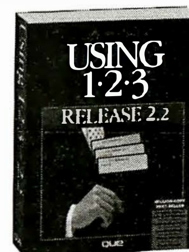
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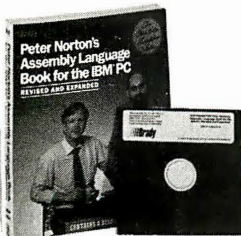
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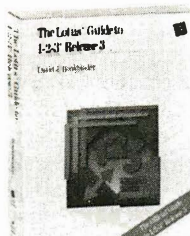
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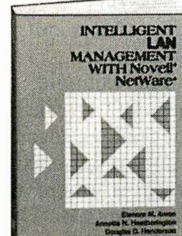
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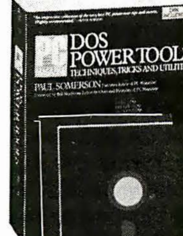
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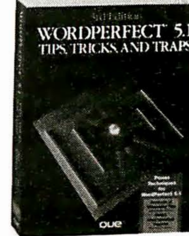
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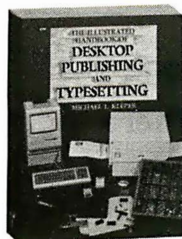
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Who's Who in CMIP?

Different groups of vendors have carried the CMIP torch. These days, the controlling group, formed in 1988, is known as the Open Systems Interconnection Network Management Forum (OSI/NM Forum). It includes "essentially all the major computer and telecommunications companies in the world," says David Mahler of Remedy.

"We got together two years ago because the feeling from our customers was that even if you still have proprietary networks out there, it is necessary for the network management systems to talk to each other. It would be wonderful if everyone moved to totally standards-based networks, but reality suggests that that isn't going to happen overnight. So, the companies got together to devise a way to let the management systems talk to each other."

Mahler points out, too, that the fact that the organization chose the OSI network management protocols doesn't imply anything about the structures of the underlying networks. "We chose OSI rather than anything else. We could have picked SNMP or a proprietary protocol, but because [the Forum] was designed as an international organization from the start, we picked an international standard. It has almost nothing to do with whether the network itself is OSI; it just uses the OSI mechanism."

The purpose behind the OSI/NM Forum is to make sure the vendors all make the same choices along the way toward developing products from the protocol specifications, Mahler says. "There are three phases to forming a standard. One is generating the base standard, which is performed by standards bodies. When you generate the base standard, you build in options for implementing it." So, when the implementation takes place, vendors produce "implementation agreements" to make sure everyone selects the same options.

The third part is developing a suite for testing interoperability and conformance. Mahler explains, "The OSI/NM Forum didn't want to get involved with that, so we contracted with the Corporation for Open Systems," which also helps develop conformance testing for other OSI protocols. "We're squarely an implementors' group." Almost constantly, some subcommittee is meeting somewhere; in addition, the organization has plenary meetings every quarter. "It's different from a lot of organizations, because it's much more like a multicompany project."

Much of the CMIP versus SNMP rhetoric present in earlier years was due to a different group of vendors. The CMOT group proposed running CMIP protocols over TCP/IP networks—hence the name: CMIP over TCP/IP, or CMOT. "The CMOT spec is [from] quite a different group of people with different attitudes," Mahler says. "My particular opinion, and I think you'll find it to be the general consensus, is that CMOT is dead. It lost its market window, and SNMP has very well filled the role of management protocol for TCP/IP. The SNMP community delivered more functionality, faster, to the marketplace."

The OSI/NM Forum's role is different, Mahler insists. "The CMOT community was working on the problem of managing TCP/IP devices. That's the same thing that SNMP was doing. The Forum worked on a very different problem. [Its members] didn't care what network you were trying to manage. They said the management systems had to talk to each other and were largely independent of the kind of network out there."

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standard controlled by international standards bodies such as the ISO. Vendors can test their implementations, says Mahler, against a conformance test suite from the Corporation for Open Systems (COS), which also performs conformance tests for other OSI protocols. In addition, through public demonstrations such as Interop's, as well as more private ones, vendors can demonstrate that their products interoperate.

SNMP, in contrast, is not an international standard, although, like TCP/IP, it is controlled by the Internet Activities Board. Vendors primarily check their implementations with interoperability testing.

Some organizations, international ones in particular, may find that they are required to go with protocols that meet international standards. "The reality is that we're in North America, where TCP/IP is very popular, and so SNMP is [very popular, too]," explains Mahler. "But that's not true on a worldwide basis."

For example, although the Government OSI Profile of the U.S. government does not yet cover network management, it does require using other OSI protocols in cases where they're applicable and available (see "The Latest GOSIP," June 1990 BYTE). It's logical to assume that future implementations of GOSIP will require CMIP.

SNMP has one advantage: There are more products supporting it.

• *Availability of products*. If practicality is the most important principle to you, SNMP has one undeniable advantage: There are a lot more products supporting it than CMIP. "There's certainly a lot of interest in CMIP, but it doesn't have many interoperable implementations today," says Case. "People can go off and buy lots and lots of products based on SNMP: routers, Ethernet hubs, fiber devices, Ethernet devices—the list goes on and on. I don't think the same is true for CMIP."

For this reason, Case is less concerned about the standards issue. "The standards that are the most interesting to me are the ones that are *used*, not the ones that are blessed but not implemented."

Vendors confirm the dichotomy. "We talk of a 'selling standard' and a 'buying standard,' " says Steve Saltwick, area

manager for networking products at Tandem Computers in Cupertino, California. Customers insist on current or future support for OSI protocols, but they aren't buying such products yet, he says. "OSI is a 'selling' standard—customers want to be able to move to it—but customers are buying SNMP."

Mahler concedes that fewer CMIP implementations exist, but he says it's only a matter of time. "The first year that SNMP came out, there were only three or four [implementations]. The second year, there were 12 to 14. The third year, 30 some. [CMIP] will go through a similar pattern," he predicts. Case agrees that CMIP products are in development and on their way: He's even implementing one himself. (To tell who the CMIP players are, see the text box "Who's Who in CMIP?" on page 188.)

Network Detente?

The future, Mahler and Case agree, will see CMIP and SNMP devices working together to manage networks. "SNMP is focused a little more on the manager-to-device area, whereas the Forum implementation of CMIP [see the text box "Who's Who in CMIP?"], which is the most active area right now, is focused on communications between management systems," Mahler says. "We think that the two have largely complementary roles."

"What you may find is that SNMP will be used for some parts, and CMIP will be used for others," concurs Case. "You may find a time where the 'manager of managers,' based on CMIP, is interacting with the SNMP manager to control a particular LAN—SNMP within Dallas, but CMIP between Dallas and Chicago. It's not an either-or."

While this may sound complex, it's not all that different from the way programming languages work now, Case points out. Programmers don't try to write everything in the same language; they work with a "toolbox" of languages, each designed for a specific purpose. "There are dozens of network management protocols today," he says, citing IEEE 802.1, FDDI's SMT, IBM's NetView, DEC's NICE, and IBM/3Com's CMOL as just a few examples. "I wouldn't be surprised if there were more in the future. SNMP and CMIP are the two that happen to be getting the most attention [right now]." ■

Sharon Fisher is a San Francisco-based freelance writer specializing in computer communications. She can be reached on BIX as "sharonfisher."



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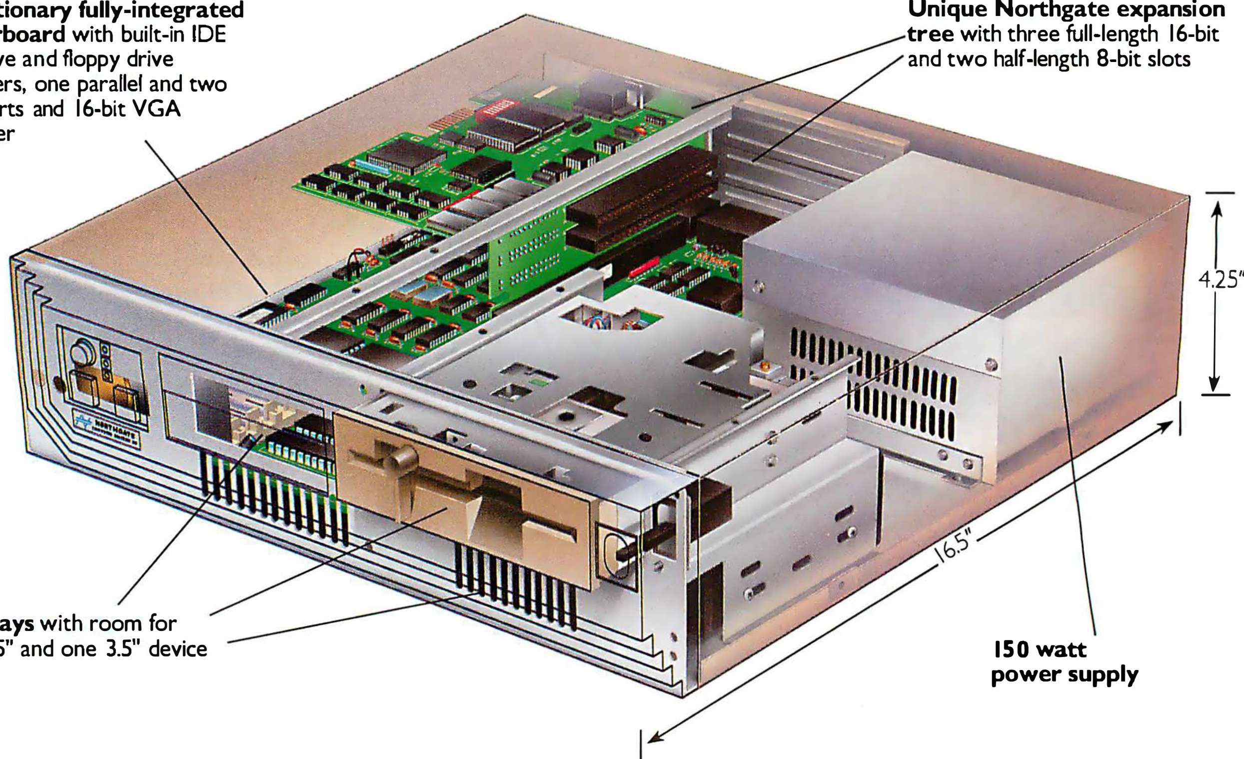
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PREVIOUS ADDRESS ______
EMPLOYER ______ DATE OF EMPLOYMENT MO. ______ YR. ______
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c. Joint Applicant's Personal Information

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SOCIAL SECURITY NUMBER ______ DATE OF BIRTH ___/___/___
ADDRESS ______ CITY ______ ST ______ ZIP ______
DATE OF RESIDENCE MO. ______ YR. ______
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MANAGING BIG BLUE

IBM provides some serious network management tools for serious networks

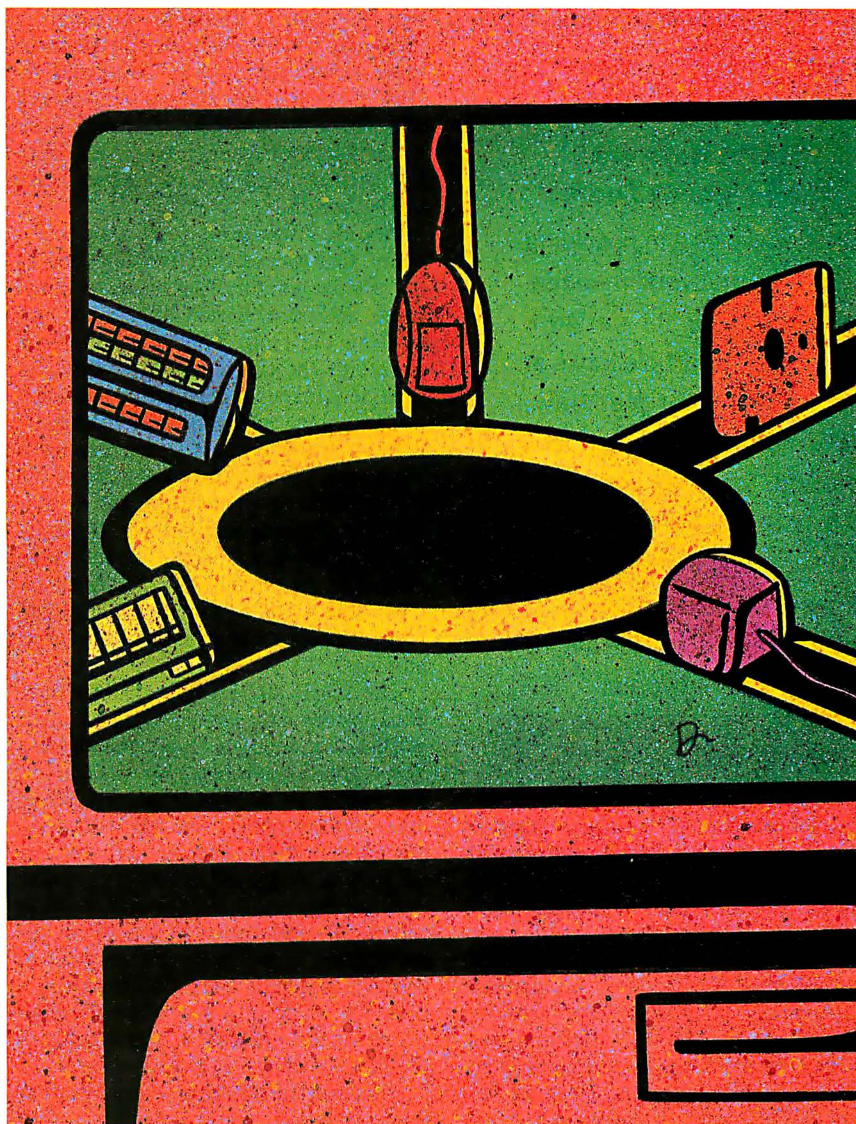
BARRY NANCE

Orchestrating a 50-node LAN by hand often means fumbling in the dark to solve problems. You fall back on trial-and-error methods to determine which components may have caused a network failure. You know the locations of the workstations because you moved them yourself. You know which network adapters are in which machines because you installed them. When a network reconfiguration is called for, you stay up late with pencil and paper to map out the new layout. If a problem occurs, you find out about it when someone walks into your office with a complaint. When you need to investigate, you walk to that cubicle to see what's going on.

On that scale, managing a network is rather easy. But what if you had a thousand network nodes to manage? Or ten thousand? What if the nodes were scattered across the city? The country? What if you managed several different Token Ring LANs, all connected to a central mainframe and all part of a nationwide network?

Consider the administrator of a large, sophisticated network at work:

The network administrator notes the network alert that pops into the upper right corner of the LAN Manager screen. She picks a menu selection and looks at the alert in detail: A link error has occurred, and it has brought down a LAN bridge in the engineering department. Choosing other menu options, she reconfigures a standby bridge to temporarily substitute for the failed unit. The phone rings. "I just lost my connection to file server 3!" complains someone from Engineering. "I know," the administrator



says. "Reboot your computer and log back on. The file server is still up; it was just the primary bridge that failed. I've routed around it. Would you tell the other folks in Engineering to also reboot their computers and log back on?"

After a few minutes, the administrator checks her work from her workstation, asking LAN Manager to poll the network adapter cards on that part of the LAN. After receiving positive responses, she calls a repair technician to have the failed bridge unit serviced.

The Secret Life of Token Ring

Token Ring has always had amazing capabilities in the areas of internal diagnostics and ring management, capabilities that have gone largely untapped by network management software. Unlike ARCnet and Ethernet, Token Ring LANs circulate a constant stream of Medium Access Control frames that provide a wealth of information regarding the network's status. The network adapter cards use these MAC frames privately to keep the network running, but network management applications can intercept them to reveal what's happening under the covers.

Few vendors offer software tools that capture these MAC frames for network management purposes. One vendor—IBM—augments the MAC frames with another protocol layer of management services as defined by the Systems Network Architecture. In large companies, Token Ring LANs are often part of SNA networks. SNA is an IBM standard for networking that encompasses just about everything. Terminals, PCs, LANs, controllers, mainframes, and even remote printers come under the SNA umbrella. An SNA network node is characterized as either an *entry point* or a *focal point*. An entry point can generate SNA statistics and status information; a focal point receives the data and presents it to an operator.

Within SNA, IBM has defined a Management Services standard that defines how network management products talk to one another. For example, the IBM standard says that an alert (a record of an error or other significant event) includes such fields as the address of the node at which the error occurred, the date and time of the error, the ID of the management component reporting the error, the probable cause, and a recommended action. (Of course, the node initiating the alert may not be able to fill in all these items.) Although it was developed by IBM, SNA is nonetheless a well-known and fully documented standard that many computer manufacturers adhere to so that their hardware and software are IBM compatible.

Not all Token Ring workstations are peers. One workstation is designated as the active monitor, which means it assumes additional responsibilities for controlling the ring. The active monitor maintains the ring's timing control, issues new tokens (if necessary) to keep things going, and generates diagnostic frames under certain circumstances. The active monitor can be any one of the workstations on the network and is chosen when the ring is initialized. If the active monitor fails, there is an automatic procedure by which the other workstations (the standby monitors) negotiate with one another to choose a new active monitor.

The IEEE 802.5 (Token Ring) standard defines six types of MAC frames. A workstation sends a Duplicate Address Test frame when it first joins the ring, to ensure that its address is unique. To let other workstations know it's still alive, the active monitor sends an Active Monitor Present frame every so often. Other workstations periodically send a Standby Monitor Present frame. A standby monitor sends Claim Token frames when it suspects that the active monitor may have died. A workstation sends a Beacon frame in the event of a major network problem, such as a broken cable or a workstation transmitting without waiting for a token (i.e., going out of turn). And a Purge frame is sent after a ring initializes itself or after a new active monitor is established.

Network management software locates the active monitor on the LAN by looking for the Active Monitor Present MAC frames. Software watches for Beacon frames and uses them to trigger diagnostic actions. Using the standard ring-polling technique defined in the IEEE 802.5 Token Ring specification, the software can also determine the status of each network adapter card on the network. If an adapter is found to be disabled and the Token Ring LAN is part of an SNA network, an alert can be generated. When errors occur on a Token Ring workstation, the real culprit is sometimes a different workstation. The *nearest active upstream neighbor* (NAUN) workstation, the node responsible for passing a token or frame downstream to this workstation, may have malfunctioned and corrupted the data. Network management software can detect the NAUN relationship and use it to point you in the right direction.

SNA on Token Ring

Above the MAC layer, SNA Management Services provide that Logical Link Control layer frames can be issued by either a focal point or an entry point that needs to perform management tasks. If SNA-aware support software is loaded into a workstation, that workstation can be queried, tested, and diagnosed from a remote location. SNA is rich in management and maintenance functions. It defines services for performing traces, recording memory snapshots (even from a remote system), requesting or responding to tests, and generating and recording statistics.

To trace events on a particular segment of the network, for example, the focal point issues an Activate Link (ACTLINK) request. It follows up with an Activate Trace (ACTTRACE) request, records the resulting Record Trace Data (RECTRD) events, and finally issues a Deactivate Trace (DACTTRACE) request. The RECTRD messages contain the link address, the trace type, and the trace data. An ACTTRACE request might specify that the trace include data for an entire segment (transmission group) or for a specific link.

A Request Maintenance Statistics (REQMS) request asks an SNA node to report resource maintenance statistics and specifies whether those statistics counters should be reset after being reported. A Token Ring workstation on an SNA network can respond to this request

BYTE ACTION SUMMARY

IBM'S Network Management Tools

IBM is well along in providing integrated network management tools for its network offerings. This article looks at the workings of NetView, IBM's network management solution for SNA systems, and IBM's LAN Manager, which lets you manage Token Ring systems. It provides an understanding of how to manage IBM networks.

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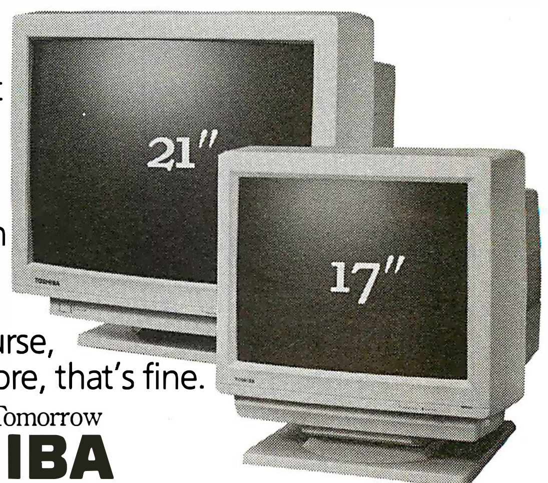
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(But to us it sounds like kdsqatrz.)



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with adapter engineering change level data, network software version data, traffic counts, and error counts. If error counts exceed predetermined thresholds, the workstation can initiate the sending of these statistics even without receiving an REQMS message.

As you can see, SNA is not lacking in services for network maintenance and management.

The View from LAN Network Manager

IBM's LAN Manager helps network administrators manage Token Ring LANs, especially those that are part of larger SNA networks. It provides a simple menu interface that works with NetView (a mainframe IBM product) or by itself on a single- or multisegment Token Ring network. Do not confuse IBM's LAN Manager with Microsoft's LAN Manager: The IBM offering is a true network management application, while Microsoft's product is a network operating system. IBM has announced a name change for its product; beginning in April, it will be called LAN Network Manager.

IBM LAN Manager is Systems Application Architecture–compliant, and the renamed version will run under OS/2 Extended Edition Presentation Manager. It will use OS/2 EE Database Manager to store and retrieve network configuration data and network error-event histories (alerts). The current version maintains configuration files and alert lists, but these are not accessible with Structured Query Language commands.

IBM says that version 1.1 of the application will be available late this year and that it will add more NetView commands (80 commands, up from 12), more protocols, and a pictorial (graphical) representation of the LAN. Version 1.1 will also use the ISO Common Management Information Protocols (CMIP) and will encode data according to the "Specification of Basic Encoding Rules for Abstract Syntax Notation" (ASN.1, ISO 8825). Byte-flipped machines, such as Intel-equipped IBM PCs, will be able to nonchalantly communicate with Apple, DEC, and Sun computers. IBM obviously wants to be a friendly neighbor when it comes to multivendor network management.

Running alone, LAN Network Manager acts as a focal point on a network. When used with NetView, though, it is also an entry point (i.e., an agent) to the mainframe product. When used as an entry point, LAN Network Manager is, in SNA terms, a System Services Control Point node. It uses an SNA SSCP–Physical Unit communications session to talk to NetView. There are usually several SSCPs in an SNA network, and they provide essential management services: helping to activate or deactivate the network, allocating network resources, managing the recovery of the network from communications failures, collecting traffic data, interacting with network operations people, executing their commands, and coordinating the interconnection of the different segments of the network. NetView itself is an SSCP node that offers central management of a large, geographically diverse network.

What does this do for you? Network management operations can be initiated and controlled from any terminal or workstation on the network, whether or not it is physically part of the Token Ring network being managed. This is especially useful to network administrators

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TEXAS INSTRUMENTS

who are geographically remote from the LANs they care for.

NetView Close-Up

NetView incorporates and combines the features of several other IBM mainframe products. Network Communications Control Facility (NCCF) works across multiple-domain networks to record alerts, divide management responsibilities among several network operators, and run command-script programs. Network Logical Data Manager records session/routing information, including response-time data. Network Problem Determination Application analyzes network problems and presents the results at several levels of detail. At the lowest level, NPDA reveals the probable cause of an error or failure.

NetView integrates these and other functions into a simple menu-driven management application. A NetView operator can easily look at a particular SNA node's health, as well as analyze statistics or reconfigure (or reset) network devices. For instance, a LAN Network Manager or NetView operator can reconfigure a LAN bridge to have a different network address or a different hopcount limit (i.e., the maximum number of bridges through which a frame can pass on its journey). From either NetView or LAN Network Manager, you can collect performance and traffic statistics from LAN bridges, including a count of the frames that have been discarded or not forwarded because of error conditions, and a count of broadcast frames intended for reception by all workstations.

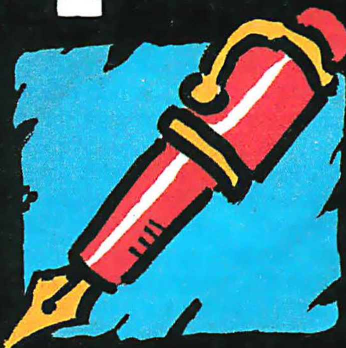
You can also use NetView's NCCF to query or command LAN Network Manager without actually sitting down at a LAN Network Manager workstation. You can ask for the current status of a Token Ring node, remove the node from the network, perform a point-to-point test between two nodes, reset LAN Network Manager, and ask for a display of the current configuration of a LAN segment.

There are two ways to programmatically control NetView or to obtain network status and event history information from it. NetView incorporates a script file processor that an administrator can use to automate the system's response to certain events. Programming the script language facility embedded in NetView is much like writing scripts for a PC communications program. For instance, you can easily write a program that wakes up when a particular kind of alert is received. Your program might try to recover automatically from the error by sending a reset-device command to the problem node.

The application programming interface to NetView is more complicated, but it allows custom-written programs in a high-level language to access NetView configuration data files and alert histories. An application program can also use the NetView API to trigger an alert of its own—perhaps to signal a problem with a database file. NetView records the resulting alert in its history file and takes an appropriate action (as you define it). This action might consist, for example, of a notification that operator intervention is required.

A new aspect of the NetView API is an LU 6.2 (peer-to-peer communications) facility. LU 6.2 is a dialogue-oriented protocol within SNA. With simple verbs, such as `Allocate`, `Receive-and-Wait`, `Send-Data`, `Confirm`, and `Deallocate`, the LU 6.2 protocol makes it easy to query NetView or perform custom net-

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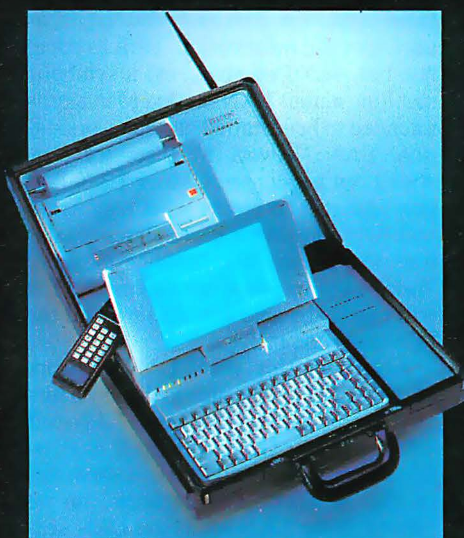
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work management tasks (implemented by a staff of programmers, of course).

Another IBM product, NetView/PC, provides an API to NetView that other vendors can use to interface with their equipment. Such companies as Synoptics, AT&T, Paradyne, and Codex have products that work with NetView and are based on the NetView/PC interface. The devices that use this interface include Ethernet adapters, modem management hardware, and T-1 network resources.

Auditing and Controlling Your LAN

LAN Network Manager works with other IBM products to control access to the network. Beginning in April, it will let you set up rules saying when certain workstations can log on. In conjunction with the IBM LAN Station Manager and 8230 Token Ring Controlled Access Unit, LAN Network Manager can detect intruder log-ins, generate an alert, and automatically remove the offender from the network by reprogramming or resetting the 8230 CAU. LAN Network Manager itself is, of course, password protected.

Do you know exactly where all your company's PCs are located? LAN Network Manager, LAN Station Manager, and the CAU work together to help you map your LANs as they change over time.

The CAU incorporates a data-reporting function that notifies LAN Network Manager of adapter, lobe, and segment identifications for the workstations on the LAN. The LAN Station Manager will be available late this year and will come in both DOS and OS/2 versions. It collects device information from each workstation and then sends the information to LAN Network Manager. It maintains a station database that contains user-specific information, such as room number, serial number, and a symbolic machine name. LAN Station Manager is intended to be installed on each workstation. LAN Network Manager (or NetView) can trigger the CAU or LAN Station Manager to report what they know and thus correlate a particular workstation with a particular building location. Voilà!—instant asset management. You will finally be able to track down all the PCs in the company.

Also later this year, LAN Network Manager 1.1 will be able to display a pictorial representation of your LANs. It will use IBM's GraphicsView/2 to show OS/2 workstations and their node status on the network. The network can be viewed at the LAN level, the LAN segment level, or the LAN access unit/lobe level. Another product, NetCenter, also uses graphics to depict the network. It provides yet another control/monitor function to the operator. Running under PC-DOS, NetCenter lets you manage both SNA and non-SNA resources on a NetView network.

I mentioned that IBM will use CMIP in its new products; be aware that IBM's CMIP and SNMP usage will be fairly limited. One of the few places CMIP comes into the picture is between the new CAU device and LAN Network Manager. Other diagnostic and management functions within the network will generally not be CMIP-compliant. The primary protocol that IBM uses in its network management products is defined in SNA's Management Services, and this will remain true for years to come. However, with its TCP/IP release 2 product, IBM does provide the means for device faults that originate in SNMP nodes to be recorded in the central Alert List. An IBM developer said that future CMIP support would be added as the definition of CMIP becomes clearer.

The Right Tool for the Right Job

Token Ring has hidden strengths, and it's too bad there aren't more network management applications that take advantage of them. I believe LAN Network Manager is the first network management product to fully use the management information inherent in every Token Ring LAN, along with the network management standards that IBM laid down as part of SNA. The internals of Token Ring and SNA are certainly not confidential. Perhaps soon we will see other tools from other vendors.

In the meantime, though, these products from IBM can give you an inside look at the health of your network. LAN Network Manager and NetView are sophisticated yet simple. But don't try to buy them for a small office LAN; these are big-time tools for large networks. If you have at least a medium-size Token Ring LAN, you *might* want to consider getting LAN Network Manager. It will set you back about $4000 (one-time fee). NetView for a mainframe is more expensive—approximately $3000 per month in license fees, depending on processor type and operating system. But when you need tools like these, you need them badly. ■

Barry Nance is the author of Network Programming in C *(Que Publishing, 1990) and the editor for the IBM Exchange on BIX. You can reach him on BIX as "barryn."*



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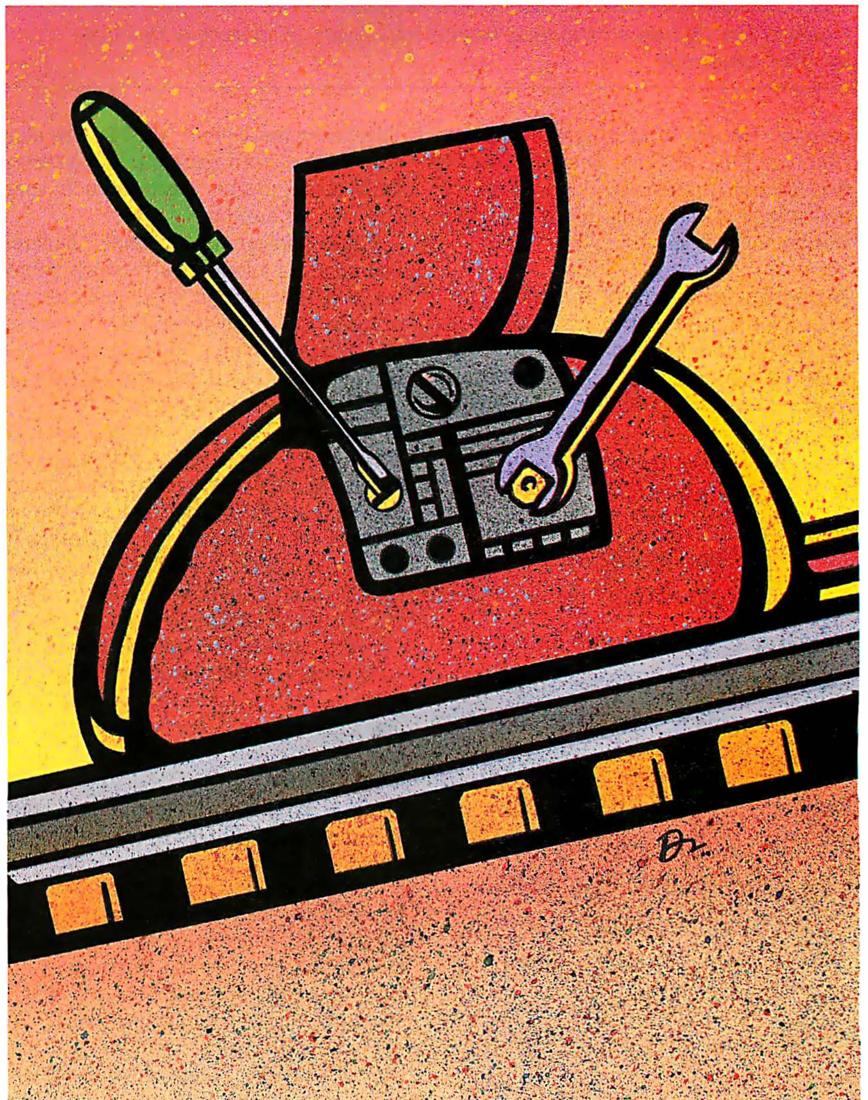
FINDING FAULT

As networks become more widespread and important, fault management and performance monitoring become business necessities

STEVEN M. DAUBER

At Boeing in Seattle, a computer network helps operate the 747 aircraft assembly line. At Wells Fargo Bank, the entire nationwide system of automated teller machines communicates with central computers by way of computer networks. A computer network helps run Apple Computer's Macintosh automated production facility.

Networks are rapidly becoming the lifeline of businesses worldwide. Because networks provide distributed control, better scalability, resource sharing, and, ultimately, cost advantages over mainframes and minicomputers, companies are moving their mission-critical applications to multiplatform networks. With this movement, thorough network management becomes vital to a business's success.



Paying the Price

In recent studies, major corporations have reported capital losses of astounding magnitude when they have had problems with their networks. One study calculated the average lost productivity resulting from network problems to be in excess of $3 million per year. It also found that the average network is completely or partially disabled about twice a month, for an average period of more than half a business day.

Many other companies have since echoed the primary conclusion of these studies: Network downtime, the time that the network is either down or degraded, can cause extreme monetary loss, particularly when it affects mission-critical data. As companies recognize the increased importance of their networks,

ISO NETWORK MANAGEMENT

Area	Issues
Fault management	Detects anomalous network behavior Isolates network problems Attempts to control network problems
Performance management	Analyzes network error rates Analyzes network throughput Attempts to create optimal network performance
Configuration management	Detects physical and logical configurations Understands and manipulates network state
Accounting management	Collects resource utilization data Processes resource utilization data
Security management	Controls network access

Figure 1: *The ISO network management model divides management functions into five subsystems.*

pressure mounts to keep systems up and running. This, in turn, puts pressure on the vendors, fueling the demand for the network application of the 1990s: network management.

Network Management Today

Network management's twin goals are to reduce the number of network problems and, once problems occur, to minimize inconvenience and contain the damage.

BYTE ACTION SUMMARY

Monitoring Networks

Network downtime can have a serious effect on your company's bottom line. This article details a four-step process that lets you correct network faults systematically. It also describes network problems and solutions and discusses the importance of both fault management and performance monitoring.

To achieve these goals, the ISO has identified five management subsystems: fault, configuration, performance, security, and accounting.

Fault management detects, isolates, and controls anomalous network behavior; configuration management attempts to understand and control the network's state; performance management analyzes and controls the network's throughput; security management controls access to network resources; and, finally, accounting management records and processes network resource-utilization data. Figure 1 lists the issues that these network management areas address.

Four important network management product categories deal with these issues: physical-layer tools, network monitors, network analyzers, and integrated network management systems. Each category has an essential role to play in today's large, heterogeneous networks.

Tool Types

Physical-layer tools include time-domain reflectometers (TDRs), oscilloscopes, breakout boxes, power meters, and similar products that find problems such as cable opens and shorts, unterminated cables, and poorly functioning connection hardware. (See the text box "Let's Get Physical" on page 212 for details about network cable management.)

Perhaps the most popular physical-layer tool is the TDR, which sends signals along the physical medium at regular intervals. The returning signal reflections provide a representative waveform showing the placement of network devices and cable problems. TDRs provide a reasonably accurate estimate of the location of physical media problems. Since a large percentage of network faults occur at the physical layer, most companies with large networks own and use TDRs or similar products. TDRs are currently priced from about $1500 to more than $10,000.

Network monitors are computer devices that attach to a network and monitor all or a selected portion of the network traffic. By examining frame-level information in each packet, network monitors can compile statistics on network utilization, packet type, number of packets sent and received by each network node, packet errors, and other important variables.

Network monitors are relatively inexpensive, permitting you to use one per network segment. They are generally allowed to run unattended 24 hours per day, recording data and looking for anomalies. The monitors' primary advantages are relatively low cost, reasonable error-detection facilities, and the ability to participate in integrated network management schemes. Network monitors are priced from several hundred dollars (for software-only products) to about $10,000.

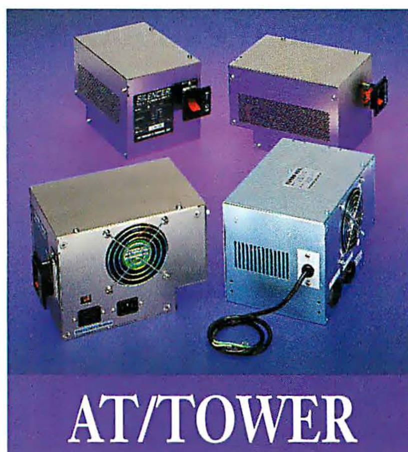
While network monitors can detect network problems, network analyzers can help you track down and fix those problems. Network analyzers contain sophisticated features for real-time traffic analysis, packet capture and decoding, and packet transmission. Some even include troubleshooting expertise, in the form of test suites. Network analyzers also incorporate a built-in TDR-like capability. The most sophisticated network analyzers use special-purpose hardware to detect problems not visible to standard network controllers.

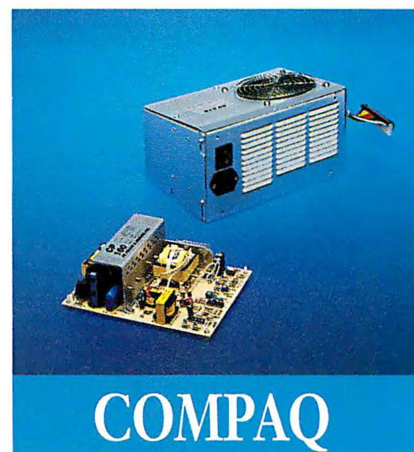
Prices for network analyzers start at about $10,000, and they can cost well over $30,000 with support for multiple physical media and protocol decoding. They are sold as *kits* (a network interface card and software that you install on a PC) and as *packages* (the card and software preinstalled in a PC of the vendor's choice), with the latter being substantially more expensive.

The fourth and final type of product available for managing a network is the integrated network management system. Using the INMS, you can monitor and control your entire network from a central location. The INMS implements all

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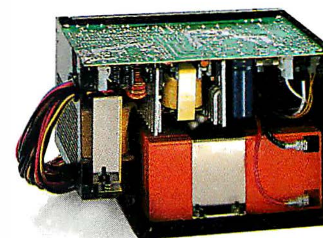
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TYPES OF NETWORK MANAGEMENT PRODUCTS

Product type	Strength	Weakness
Physical-layer tools	Reasonably accurate	Some are complex and difficult to use Limited to physical-layer problems
Network monitor	Continuous monitoring useful for long-term trend analysis Low cost	Limited troubleshooting capability
Network analyzer	Advanced troubleshooting capability Portable Can stress-test new protocols, applications	Relatively expensive
Integrated Network Management System	Advanced monitoring capability Supports all five ISO network management subsystems	High cost Unavailable for some platforms

Figure 2: *Network management tools can be classified into four types. Each type has its corresponding strengths and weaknesses.*

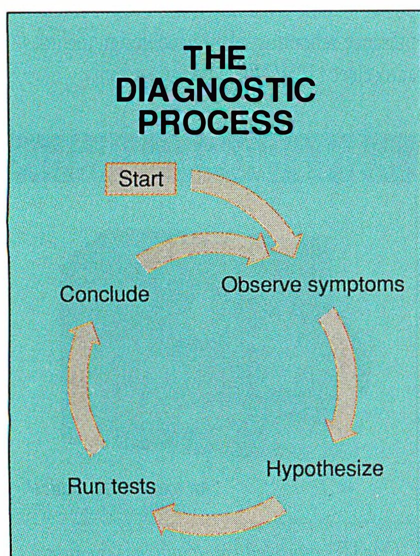


Figure 3: *The network diagnostic cycle resembles a blackboard system, where successive cycles contribute toward the solution to the problem.*

five ISO network management areas: fault, performance, configuration, security, and accounting. You use the INMS through a console device that provides a graphical user interface. The console device is integrated with a network management station that communicates with agents—software programs—on remote computer devices to determine the state of the network. Agents collect interesting information, such as the number of packets the device has received, and make it available to the INMS upon query. When a problem occurs, agents can also send alarms to the console to immediately alert the network manager.

INMSes hold tremendous promise but have to be implemented across a wide variety of platforms to be truly effective. Resolving differences between operating systems, hardware platforms, and networks makes this task difficult and time-consuming. As a result, INMSes are the most expensive network management products. In the coming years, you will see an increasing number of product introductions in this area. Figure 2 compares the various strengths and weaknesses of the four types of network management products.

Using the Tools

If you've spent any time managing a network, you know that this often-difficult task is both a science and an art. As a science, troubleshooting demands that you understand network operation and the relationship between symptoms and underlying causes. As an art, it requires that you implement the proper diagnostic process, which consists of four critical steps repeated continuously until the problem is ultimately solved: observing symptoms, developing a hypothesis, testing the hypothesis, and forming conclusions (see figure 3).

The first step of the process is to observe problem symptoms. A common mistake here, made in the interest of saving time, is to begin experimentation before thoroughly examining the symptoms. Unfortunately, in many cases, the most obvious symptoms can lead you off on a costly tangent. Why are the most obvious symptoms not always the most important? To understand this, you must understand the essence of network protocols.

Have you ever wondered why a computer sometimes takes so long to respond to a network access request? The reason is that network protocols are designed to hide, not to expose, network problems. Most network protocols incorporate retry mechanisms and other techniques to recover from problems. As a result, most network problems display a single obvious symptom: long response times. Although retry mechanisms increase network reliability, they also make network troubleshooting more difficult by displaying a common symptom for many different problems.

Therefore, it is critical that you uncover as many clues as possible prior to the beginning of the next step in the diagnostic process. Since the first symptom that is encountered—longer response times—may not be very illuminating, you must push not only to identify the other symptoms, but also to discover the following:

- The range and scope of the symptoms. Does this problem affect everyone, everyone in a given area, random individuals?
- The percentage of time the problem manifests itself. Is the problem continuous or intermittent? Does it occur regularly?
- What has changed recently? Has a computer device been added to the network? Have any internetworking devices been reconfigured?
- All release variables in the environment experiencing the problem. What are the vendor and release numbers of the computer systems, network interface cards, hubs, routers, bridges, application software, and network software?

As soon as you have gathered all this information, you can then move to the

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next step in the diagnostic process: the formation of a valid hypothesis that is consistent with the data.

Signature Analysis

Before you can use the data gathered about problem symptoms and construct a valid hypothesis, you have to know whether what you're seeing is something unusual. Therefore, you first have to understand the "usual." Networks are like fingerprints—no two are exactly alike. Even if two networks are configured identically, usage patterns will almost certainly differ. The process of determining the characteristics of an individual network signature is called *baselining*.

Development of the troubleshooting library is one of the most effective ways of minimizing network downtime.

Baselining is not one of the four steps in the diagnostic process: It must be done prior to a problem occurring. (Needless to say, once the problem situation exists, observing typical network performance is impossible.) Having a proper baseline for the network means you can answer detailed questions about the following:

- *Network utilization*. What is the average network utilization? How does it vary during the business day?
- *Network applications*. What are the dominant network applications on the network? What version numbers is it running?
- *Network protocol software*. What protocols are running on your network? What are the performance characteristics of these protocols?
- *Network hardware*. Who manufactured the network interface controllers, media attachment units, hubs, and other network connection hardware? What versions are they? What are their performance characteristics?
- *Internetworking equipment*. Who manufactured the repeaters, bridges, routers, and gateways on the network? What versions of software and firmware are they running? What are their performance characteristics?

This list is by no means complete, but it provides an example of the necessary level of detail. In general, the better you know the network, the less frequently problems occur and the more quickly they are solved when they do occur. This will be increasingly true as networks become more complicated.

Theory and Experimentation

Armed with the appropriate data about problem symptoms and a complete understanding of differences between the data and corresponding baselines, you are ready to form a first hypothesis of the problem. This is the stage where troubleshooting experience and expertise is most important.

You need to know which network problems are capable of causing the observed deviation from the baselines. This often requires a good understanding of the protocols and applications running on the network. For example, too many collisions on an Ethernet are often a result of excessive network traffic but can also result from overlong segments or malfunctioning transceivers.

You can gain troubleshooting expertise from experience or from several books on the subject. Recently, some network analyzers have incorporated online troubleshooting guides that give tips on probable causes of observed symptoms. Using all this information and expertise, you form a hypothesis.

The next step in the troubleshooting process is to test the hypothesis. A network analyzer is usually the best tool for this purpose, since it provides the most flexible set of capabilities. Some network analyzers offer important features that aid the test-development process, such as preprogrammed experiments. Each experiment is designed to test one or more hypotheses, thereby saving you the hassle of programming the test parameters.

Following the experiments necessary to test the hypothesis, you enter the final step in the diagnostic process: forming conclusions. If the other steps were executed correctly, this step may well be the most straightforward. Good network troubleshooters know what they will conclude for each possible outcome of the experiment. In the event that the test results are unfamiliar, you must expand or revise your view of the problem so that

Let's Get Physical

John Kaiser

The scope of network management reaches beyond tracking network throughput. It also requires close tracking of the network's physical infrastructure—from individual PCs, telephones, and other devices to cables and cross connects. Without the proper tools and documentation, this task can become your worst nightmare. Today, a new breed of computerized cable management systems is taking the terror out of physical-network administration. By providing complete documentation of all network cabling and assets, such systems let you minimize downtime and control expenses.



One option of Isicad's COMMAND cable management system lets you highlight an individual cable path in relation to the rest of the network. (Courtesy of Isicad)

Cable management systems offer a range of features that track the complete physical infrastructure of a network. By linking graphical capabilities directly to standard, commercially available relational databases, they provide complete information on network assets using both pictures and reports.

Graphical cable management information provides pictures of your communications layout, from broad views of a complete multiple-location environment to a detailed plan of an individual circuit. By clicking on an icon that represents a network component, you can quickly locate specific information such as cable routes (see the screen), the available outlets on a given floor, or all items on a given circuit—without running lengthy reports or searching through printouts and piles of outdated floor plans.

The relational database supplements the graphics information with detailed information on every network component—from the end-to-end connectivity of circuits to the administrative information associated with each piece of equipment, cable, and cableway. It provides standard reports and documentation of characteristics such as the brand of equipment, costs, model numbers, location within the facility, and connectivity and wiring schemes.

The database can generate work orders for moves, adds, or changes; repair orders when a failure occurs; and reports on equipment schedules, cable schedules, cable tray accommodation schedules, and bills of material. It also keeps a history of changes made to the communications infrastructure.

The key to an effective cable management system is the interactive link between the graphics module and the database, which ensures that changes made in the graphical front end are automatically made to the database and vice versa. This, in turn, guarantees you up-to-the-minute information on every aspect of the communications network.

Network Troubleshooting

The combination of graphics and database information is especially important for troubleshooting activities, where it is essential to know the location of every network asset and who would be affected by a line failure or other problem. Most communications technicians spend an average of 80 percent of their time locating a problem and only 20 percent fixing it. With computerized cable management systems, this vital information is at your fingertips, so locating failures and determining who they affect is fast and easy.

Once you've located the point of failure, the cable management system provides all the documentation necessary to fix the problem. For example, if you need to replace a cable, the cable management system can describe the type of cable and what systems are connected to it and then display a floor plan showing exactly where it runs in the building.

Knowing exactly the current configuration of a network is essential. With complete documentation, both graphical and textual, on every aspect of the network, you can identify alternative circuits or routes to bypass a problem until repairs are made.

Maintaining the Infrastructure

As networks become more widespread and user turnover increases, a cable management system can help you keep up with the moves, adds, and changes necessary. With it, you can analyze proposed changes in advance to determine their feasibility and cost. The system also automatically updates the database to accurately reflect the status of the communications infrastructure.

Cable management systems and network management systems are equally vital. With both types of systems in place, you have a complete network management solution to effectively manage both the physical and logical network environments, reduce network downtime, accommodate changes, monitor and control assets and inventory, and reduce expenses.

John Kaiser is the manager of product marketing at Isicad, Inc. (Anaheim, CA), a manufacturer of integrated cable management systems. He can be contacted on BIX c/o "editors."

you can map the symptoms to the observed test results.

The diagnostic process is cyclical. Following the conclusions drawn from one test, you often need another hypothesis. Sometimes, you need to change the problem environment prior to reexamining the symptoms. For example, you might want to remove a node from the network and then observe the symptoms again. In any event, the process cycles until you can converge on the appropriate conclusion, or set of conclusions, and finally solve the problem.

The value of techniques that shorten the time taken to cycle through the diagnostic process is obvious. Baselining and gathering of anomalous data is critical to differentiating the unusual from the usual. On-line troubleshooting guides and similar features can then shorten the hypothesizing process. Finally, preprogrammed tests often minimize the testing phase. The combination of these features can dramatically reduce the length of the diagnostic cycle, providing immediate returns in the form of increased network uptime.

Incompatibilities among protocol software from different vendors are not unusual.

As you employ these techniques, you form a library of information and tests for solving common problems. With such a library, observing symptoms, forming a hypothesis, and testing the hypothesis become an extremely rapid process. Each time you solve a new problem, you should document the problem and save the tests used to solve it. The next time the problem occurs, solving it will be a simple matter. An additional advantage of this library is that it embodies expertise that can be used by anyone, not just the person who originally solved the problem. Development of the troubleshooting library is one of the most effective methods of minimizing network downtime.

Common Problems

A typical network administrator spends a great deal of time solving problems and trying to understand the network's performance. The better that understanding, the more infrequent faults are likely to be, since you avoid problems when performance is managed proactively.

Different parts of a network experience different kinds of problems. Understanding the problem sets that affect the different parts is critical to effective troubleshooting. A complete list of problems and solutions would fill volumes, but the general relationship between network components and fault types can be drawn here. For this purpose, network components will be divided into four categories: network hardware, internetworking equipment, network protocol software, and network applications.

Starting with the lowest layers of the Open Systems Interconnection model and working up, you first encounter the problems endemic to network hardware. Because hardware is subject to environmental stresses and is accessible, physical connectivity problems are the most common fault type. These include cable breaks (a cable is cut or not terminated properly), cable shorts (a cable is damaged), breaks elsewhere in the circuit (a vampire transceiver is jostled so that it no longer makes positive contact with the medium), and malfunctions in the actual network hardware circuitry (a bad network interface controller or a jabbering transceiver).

Cable problems can be discovered using a network analyzer or TDR. Problems with hardware circuitry can often be found by examining error traffic on the network using a network analyzer. Other times, these problems must be attacked by a process of elimination to isolate the problem.

As networks grow, internetworking products are increasingly common problem sources. Since these products sit at intersections within the network traffic pattern, they can quickly cause significant problems when they malfunction. Configuration errors are also common with complex products such as routers, brouters, and gateways. If nodes on only one side of an internetworking product are affected, start the search with that product. Check to see that processing queues have not grown unmanageably large. Ask yourself what has changed recently and what unplanned side effects that change might have had.

Although protocol software is just as error-prone as any other kind of software, you usually can't do more than identify these problems. For actual solutions or workarounds, consult with the vendor and obtain a new version of the software. Incompatibilities among protocol software from different vendors are not unusual. Network analyzers with built-in protocol decoders are helpful in detecting this variety of problem.

Finally, applications sometimes have bugs. There is little you can do to solve these problems directly unless your organization wrote the application. If not, use the network analyzer to find the problem and then contact the vendor with details.

Performance Management

Unlike fault management, performance management should be almost entirely proactive. However, most people tend to ignore performance management until it actually results in an emergency. The first lesson of performance management is to be proactive.

Network monitors and analyzers are important tools for completing a comprehensive traffic analysis on your network. Using these devices, you can come to understand the daily network utilization patterns, the heaviest users, the various percentages of different protocol traffic, where network bottlenecks exist, why those bottlenecks exist, and other similar information.

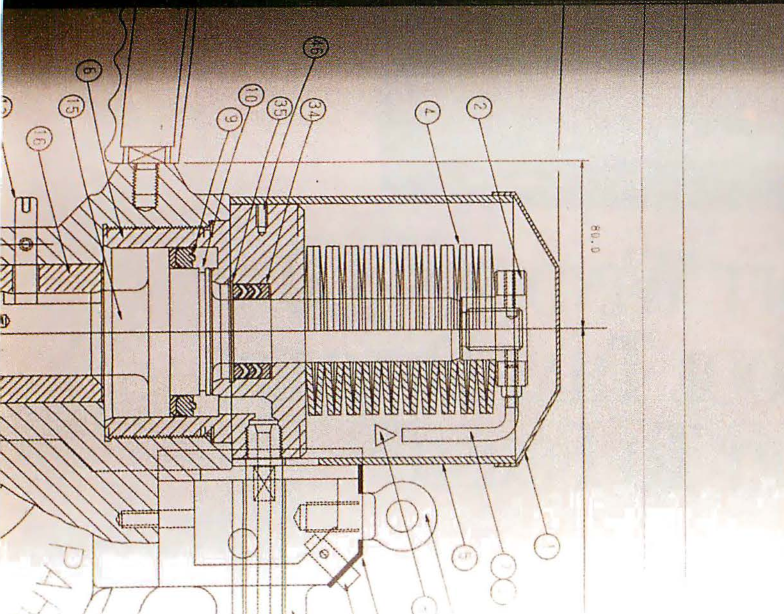
You can also use the traffic-generation capabilities of a network analyzer to study how much additional traffic the network can support. A reactive benefit from this exercise is knowing where to look first when performance problems occur, but proactive benefits also accrue, including how to best spend money to improve network performance.

As a result of analyzing the network's traffic patterns, you can make critical decisions regarding where to partition the network for optimal throughput and response time and how to allocate resources. Despite the fact that these performance management techniques are sometimes merely the result of common sense, most organizations still do not believe they have the time to engage in the exercise. Unfortunately, this way of thinking often leads to emergencies that force you to spend the time later.

Network management technology and practice has advanced significantly in the last decade. Through the 1990s, look for many of these advances to have a positive impact on networks and the people who manage and use them. ■

Steven M. Dauber is product marketing manager at Novell, Inc. (San Jose, CA). He can be reached on BIX c/o "editors."

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Network Management Sources

As networks become more complicated, the need for automated network management grows. The companies listed below deliver network management solutions for a variety of platforms.

Ashton-Tate
20101 Hamilton Ave.
Torrance, CA 90502
(213) 329-8000
fax: (213) 329-8000
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AT&T Computer Systems
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Automated Design Systems
375 Northridge Rd., Suite 270
Atlanta, GA 30350
(404) 394-2552
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Banyan Systems, Inc.
115 Flanders Rd.
Westborough, MA 01581
(508) 898-1000
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BICC Data Networks, Inc.
1800 West Park Dr.
Westborough, MA 01581
(800) 447-6526
(508) 898-2422
fax: (508) 898-3739
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Blue Lance, Inc.
1700 West Loop S, Suite 700
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(713) 680-1187
fax: (713) 622-1370
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Brightwork Development
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(508) 480-0840
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35 Industrial Way
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fax: (603) 332-4616
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Daystrom Data Products
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Digilog, Inc.
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Digital Equipment Corp.
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(508) 562-4521
Circle 1083 on Inquiry Card.

Dolphin Software
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Norcross, GA 30092
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fax: (404) 339-7905
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fax: (216) 241-2319
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fax: (617) 451-6711
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Gazelle Systems
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(801) 377-1288
fax: (801) 373-6933
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Hewlett-Packard Co.
Vancouver Division
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Camas, WA 98607
(206) 254-8110
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Horizons Technology, Inc.
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Hughes LAN Systems
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Boca Raton, FL 33432
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International Data Science
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fax: (401) 333-3584
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Internetix, Inc.
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fax: (301) 420-4395
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Isicad, Inc.
1920 West Corporate Way
P.O. Box 61022
Anaheim, CA 92803
(714) 533-8910
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J.A. Lomax Associates
659 Adrienne St., Suite 101
Novato, CA 94945
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(415) 892-9606
fax: (415) 898-0867
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LAN Support Group, Inc.
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Houston, TX 77056
(800) 749-8439
(713) 622-4900
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Microcom, Inc.
500 River Ridge Dr.
Norwood, MA 02062
(617) 551-1000
fax: (617) 551-1898
Circle 1099 on Inquiry Card.

Microtest, Inc.
3519 East Shea Blvd., Suite 134
Phoenix, AZ 85028
(800) 526-9675
fax: (602) 971-6963
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Network & Communication Technology, Inc.
24 Wampum Rd.
Park Ridge, NJ 07656
(201) 307-9000
fax: (201) 307-9404
Circle 1101 on Inquiry Card.

Network Computing, Inc.
1950 Stemmons, Suite 3016
Dallas, TX 75207
(214) 746-4949
Circle 1102 on Inquiry Card.

Network General Corp.
4200 Bohannon Dr.
Menlo Park, CA 94025
(415) 688-2700
Circle 1103 on Inquiry Card.

Network Interface Corp.
15019 West 95th St.
Lenexa, KS 66215
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fax: (913) 894-0226
Circle 1104 on Inquiry Card.

Network Management, Inc.
19 Rector St., 15th Floor
New York, NY 10006
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fax: (212) 797-3817
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Novell, Inc.
122 East 1700 South
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fax: (801) 377-9353
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Richardson, TX 75081
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(708) 505-3300
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Two Technology Dr.
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fax: (508) 898-2118
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ProTools, Inc.
14976 Northwest Greenbrier Pkwy.
Beaverton, OR 97006
(503) 645-5400
fax: (503) 645-3577
Circle 1253 on Inquiry Card.

Retix
2644 30th St.
Santa Monica, CA 90405
(213) 399-2200
fax: (213) 458-2685
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Saber Software Corp.
5944 Luther Lane, Suite 1007
Dallas, TX 75225
(800) 338-8754
(214) 361-8086
fax: (214) 361-1882
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SoftShell Systems
1163 Triton Dr.
Foster City, CA 94404
(800) 322-7638
(415) 571-9000
fax: (415) 571-0622
Circle 1256 on Inquiry Card.

Spider Systems, Inc.
12 New England Executive Park
Burlington, MA 01803
(800) 447-7807
(617) 270-3510
fax: (617) 270-9818
Circle 1257 on Inquiry Card.

Standard Microsystems Corp.
35 Marcus Blvd.
Hauppauge, NY 11788
(516) 273-3100
fax: (516) 273-2136
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(408) 988-2400
fax: (408) 988-5525
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Technology Dynamics, Inc.
145 15th St. NE,
Suite 624
Atlanta, GA 30361
(800) 226-0428
(404) 874-0428
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Telebit Corp.
1315 Chesapeake Ter.
Sunnyvale, CA 94089
(800) 835-3248
(408) 734-4333
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Circle 1262 on Inquiry Card.

TGR Software, Inc.
2 Ravinia Dr.,
Suite 330
Atlanta, GA 30346
(404) 390-7450
fax: (404) 390-7455
Circle 1263 on Inquiry Card.

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Ungermann-Bass, Inc.
3900 Freedom Cir.
Santa Clara, CA 95052
(408) 496-0111
fax: (408) 970-7343
Circle 1266 on Inquiry Card.

Unisys Corp.
2700 North First St.
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San Jose, CA 95150
(408) 434-2848
fax: (408) 434-2131
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Vitalink Communications Corp.
6607 Kaiser Dr.
Fremont, CA 94555
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fax: (415) 795-1085
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Wang Laboratories, Inc.
One Industrial Ave.
Lowell, MA 01851
(800) 225-0654
(508) 459-5000
Circle 1269 on Inquiry Card.

Woolongong Group, Inc.
1129 San Antonio Rd.
Palo Alto, CA 94303
(800) 872-8649
(415) 962-7100
fax: (415) 969-5547
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An Out-of-Towner's Introduction to the BIX Community

BIX is for people who use microcomputers for business, finance, research, and career and personal development. There's always something interesting happening here. No matter what you're into. The latest industry news. Top-notch software libraries. Private electronic mail. Real-time chatting. And every month, the complete text of *BYTE* magazine. (Read more about BIX, and how to join, on adjacent page.)

From Artificial Intelligence to Zenith Laptops...

Whatever your interest, BIX has a conference for you. Here's a partial list. (In each Exchange, Conference name appears on left, description on right.)

■ Amiga Exchange

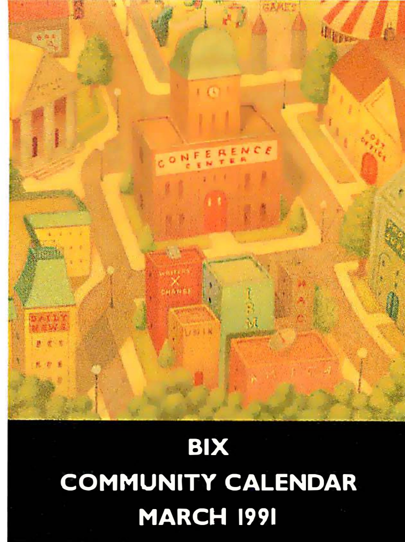
Joanne Dow, Exchange Editor

amiga.user	Exchange ideas, solve problems, compare notes
amiga.sw	Amiga programming and developer issues
amiga.hw	Amiga hardware design, use, and hookup
amiga.arts	Artistry using the Amiga
amiga.int	Developing for the international Amiga
amiga.special	Special guests and events
amiga.dev	Commodore's conference for developers

■ IBM Exchange

Barry Nance, Exchange Editor

ibm.pc	The venerable PC
ibm.at	The AT series and workalikes
ibm.ps	The PS/2 series
ibm.os2	OS/2 operating system
ibm.dos	PC/DOS & MS/DOS operating systems
ibm.os.386	Alternative 386 operating systems
ibm.utils	Utility software for IBM computers



ibm.repairshop	Garage and Tune-up Shop
ibm.new.prods	New products for IBM computers
ibm.exchange	IBM Exchange clearinghouse
ibm.listings	Index to program files in the Exchange
ibm.other	Apps, printers, modems, etc.
microsoft	Products from Microsoft

■ Interactive Games Exchange

Rich Taylor, Exchange Editor

igx.exchange	What's new in the IGX
bridge	For Bridge lovers
chess	About the game of chess
d.horizons	Role-playing games not based on fantasy
digital.gaming	Computer gaming
fun.n.games	Fun, games, group activities
gaming.college	Learn about role-playing games
other.times	Land for fun, relaxing, and gaming
the.realms	Fantasy role-playing games
town.square	On-line meeting place

■ Macintosh Exchange

Dr. Larry Loeb, Exchange Editor

mac.apple	The word from Cupertino
mac.business	Macs in the office
mac.desktop	Publishing with a Mac
mac.external	Information from all over
mac.hack	Technical information about the Mac
mac.hypercard	Using the HyperCard programming environment
mac.news	Up-to-the-minute information
mac.novice	For beginners
mac.products	Listings of new hardware and software
mac.sandbox	For off-hours fun

■ Telecommunications Exchange

Steve Satchell, Exchange Editor

bbs	Dial-up bulletin board systems
conferencing	About computerized conferencing
ham.radio	Computing, digital electronics, amateur radio
international	Telecommunications; the global computer village
networks	Information networks
packet.nets	Packet-switching networks
protocols	Small-computer communications protocols
telecomm.pgms	Telecommunications programs
telecomm.tech	New telecommunications technology

■ Tojerry Exchange

Jerry Pournelle, Exchange Editor

tojerry	Messages for and from Jerry Pournelle
chaos.manor	Computing At Chaos Manor
astronomy	A star party for amateur astronomers
contact	Science fiction meets science
disasters	Natural and man-made disasters
education	Computers in American classrooms
mathematics	Talk about high-level mathematics
sciences	Scientific programs
space	Space exploration and development
technology	New technologies and their impact

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The BYTE Lab tests nine best-selling E-mail packages for DOS- and Macintosh-compatible LANs

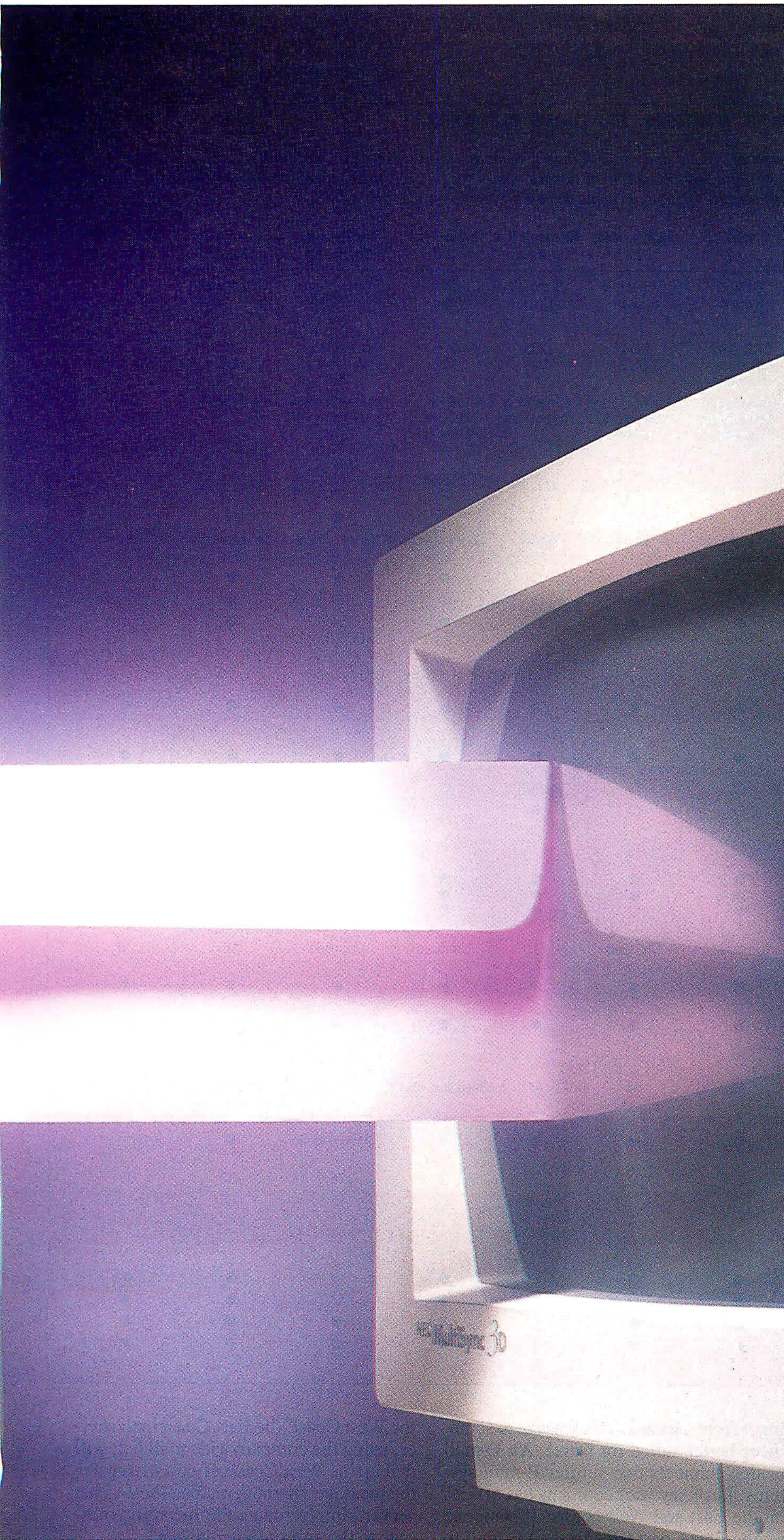
HOWARD EGLOWSTEIN AND TOM THOMPSON

Stop, look, and see if there's a letter on the network for me. Better yet, let an E-mail package do it. A good E-mail package combines the best features of a LAN-based computer: easy editing, automatic routing, and instant access to all of your correspondents, whether they're across the hall or across the country. On the inside, an E-mail system is fairly straightforward. A central database keeps track of the names and locations of all registered mail users. A separate database keeps track of individual mail messages as they're created and sent from one user to another. LANs are the medium of choice for moving E-mail from place to place. However, most packages can transmit messages across longer distances, either by way of modem over dial-up lines, through X.25 links, or through LAN bridges.

E-mail software consists of a mail engine and a user interface. The engine takes a completed mail message, deciphers the address, and moves it to its destination. Depending on the address, your message may be routed across the office via a LAN, between file servers, or across the country via gateways and bridges. Mail engines are invisible. It's important to have a reliable one, and if you expect people in your office to use E-mail, the system must have a good interface.

Mail Call

What makes for a good E-mail system? The quality of the user interface is important, as is prompt, reliable, and secure delivery. Gateways and bridges are valuable to companies with diverse sites, but not everyone needs them. Another consideration is whether an E-mail system offers front ends for the microcomputer systems and operating environments that everyone in your office is running. Some products offer front ends for Macintosh, OS/2, Windows 3.0, and even NewWave users, as well as a version for DOS users. If you want to share mail with Unix workstation users, you'll want to be sure that the E-mail vendor offers a



BYTE ACTION SUMMARY

- **E-MAIL SOFTWARE**
- **WHAT IT DOES**
  E-mail packages let you compose, edit, and send messages and attach files to them for delivery to other users. Many packages also offer optional gateways that let you exchange messages with users at remote sites or who are using a different E-mail system.
- **SHOULD YOU BUY?**
  E-mail software makes the most sense in LANs where users are geographically dispersed. In workgroups where users sit in proximity, the extra headaches of administering the E-mail system probably aren't worthwhile. For users who need to correspond with people across the building or across the country, E-mail systems can eliminate "phone tag" and improve productivity.
- **WHAT WE RECOMMEND**
  QuickMail's superb user interface, gateway options, and voice-mail capability make it our choice for AppleShare users. For mixed PC and Mac LANs (non-AppleShare), cc:Mail has the best user interface; it also includes a graphics editor and an array of gateway options. The Coordinator supports PC LANs only, but we found its ability to organize messages as ongoing communications threads particularly useful.

UUCP (Unix-to-Unix copy) or SMTP gateway (for the Unix perspective on E-mail, see the text box "E-Mail Under Unix" on page 226).

Some packages support a few specific LANs; others will work with any LAN that supports DOS 3.1 file locking. All packages offer at least a rudimentary text editor, and some offer a graphics editor as well. Some products restrict the number and type of files you can attach. And not all E-mail programs encrypt files—an important consideration if you don't want your mail read by others.

Other extras include voice-mail capability, on-line conferencing, and the ability to set up BBSes where people can post public messages. Many packages also let you call in and download your mail messages when you're out of the office. The E-mail features table on page 224 will

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E-MAIL SYSTEMS: FEATURES SUMMARY

Finding the right E-mail system starts with the computer systems and network environments you need supported. Some vendors offer and support their own gateways to E-mail services and other LAN- and host-based E-mail systems. Other vendors rely on companies like Soft•Switch to fill in the gaps. Support and licensing policies also vary considerably. (N/A = not applicable; ● = yes; ○ = no.)

Product name and version	**cc:Mail 3.15**	**The Coordinator 2.1**	**eMail 1.07**	**Higgins Mail 2.3**	**Microsoft Mail 2.0**	**InBox Plus 3.0**	**The Network Courier 2.1**	**QuickMail 2.2.3**	**Network Mail for Vines 4.0**
Company name	cc:Mail, Inc.	Action Technologies	Da Vinci Systems	Enable Software	Microsoft Corp.	Sitka Corp.	Consumers Software	CE Software	Banyan Systems
CONFIGURATION									
Workstation environments supported	DOS, OS/2, Mac	DOS,	DOS, OS/2, Windows, NewWave	DOS, OS/2	DOS, Mac	DOS, Mac	DOS, OS/2, Windows, Mac	DOS, Mac	DOS, Windows
Network environments supported	Any DOS 3.1-compatible or AppleTalk Filing Protocol-compliant network	NetWare 286/386, NetBIOS, MS-Net	Any DOS 3.1-compatible network	AnyDOS 3.1-compatible network	AppleTalk or compatible	NetWare 286/386, LAN Manager, Vines, AppleShare, TOPS, NFS	NetWare 286/386, LAN Manager, Vines, NetBIOS, MS-Net	AppleShare	Vines
Requires dedicated mail server?	○	○	○	○	○	○	●	○	○
Mail location	Server	Server or local disk	Server or local disk	Server	Server	Server or local disk	Server or local disk	Server or local disk	Server
BBS support	●	○	○	○	○	●	●	●	○
Conferencing	○	○	○	○	○	○	○	●	With Vines
Remote user access	●	●	●	●	○	●	Option (DOS only)	●	Option
Automatic forwarding to remote mail servers via dial-up connection?	●	●	●	●	●	●	●	●	●
MESSAGE CREATION									
Text editor	●	●	●	●	●	●	●	●	●
Graphics editor (formats supported)	● (cc:Mail)	○	○	○	● (PICT)	○	○	○	○
Voice-mail capability	Third-party option	○	○	○	●	○	○	●	○
Message attachment types supported:									
Text	●	●	●	●	●	●	●[1]	●	●
Graphics	●	●	●	●	●	●	●	●	●
Binary	●	●	●	○	●	●	●	Mac only	●
Attachments per message	20	1	Unlimited	Unlimited	1	Unlimited	Unlimited	16	10
Can assign message priority?	●	○	●	●	●	●	●	●	●
Message-delivered acknowledgment?	●	○	●	●	●	●	●	●	●
MESSAGE RECEIPT									
Message alert (beep, pop-up window, text prompt)	All	None	All	All	All	Beep, text, icon	All	Beep or blinking icon	Beep, text prompt
Notification via workstation TSR	●	●	●	●	●	●	TSR or NetBIOS	●	Vines redirector
TSR memory required (K bytes)	<15	8	3	3.5	25	18	78	<15	N/A
View attachments	Text only	Text only	○	○	Mac Word, Excel, PageMaker files	○	○	○	Text only
ADMINISTRATION									
Read any message	○	●	●	○	○	●	○	●	●
Delete any message	○	●	●	○	○	●	○	●	●
Purge old messages	●	●	●	●	○	●	●	●	●
Define user mail space	○	●	●	●	○	●	●	○	●

help you find the package with the features you're looking for.

Special Delivery

Anytime a mail message has to be sent off-site, there has to be a way of converting it from a local LAN message to something better suited for travel. An E-mail bridge connects two similar E-mail systems. Let's say your company has offices on the East and West coasts. If someone on the East Coast tries to send E-mail to the West Coast, the East Coast mail server, using the companywide mail list, will dial up the West Coast office and transfer the message via modem. The West Coast server simply routes the incoming message to the appropriate mailbox.

E-MAIL SYSTEMS: FEATURES SUMMARY (CONTINUED)

Product Name and version	cc:Mail 3.15	The Coordinator 2.1	eMail 1.07	Higgins Mail 2.3	Microsoft Mail 2.0	InBox Plus 3.0	The Network Courier 2.1	QuickMail 2.2.3	Network Mail for Vines 4.0
SECURITY									
User account password	●	●	●	●	●	●	●	●	●
Message/attachment encryption	●	○	●	●	○	●	●	○	○
GATEWAYS									
MHS	Option	Option	Option	Option	Third-party	Option	Third-party	Option	Third-party
User-definable gateway via scripting language?	Option	●	○	Option	○	○	●	●	○
X.400	Option	Third-party	Option	Option	Third-party	Third-party	Third-party	●	Third-party
Fax	Option	Third-party	Option	Option	Third-party	Option	Third-party	●	Third-party
SMTP	Option	Third-party	Option	Option	Third-party	Option	Third-party	●	Option
Public E-mail services:									
MCI Mail	Option	Third-party	Option	Third-party	Third-party	○	Option	●	Third-party
Western Union EasyLink	Option	Third-party	Option	Third-party	○	○	○	○	Third-party
AT&T Mail	○	Third-party	Option	Third-party	○	○	Third-party	●	Third-party
CompuServe	○	Third-party	Option	Third-party	○	○	○	●	Third-party
Sprint Mail	Option	Third-party	○	Third-party	○	○	Third-party	●	Third-party
Other E-mail gateways:									
DEC All-In-One	Third-party	Third-party	Option	Third-party	Third-party	●	○	●	Third-party
IBM PROFS	Option	Third-party	Option	Option	Third-party	●	Third-party	○	Third-party
IBM DISOSS	Third-party	Third-party	Option	Option	Third-party	●	Third- party	○	Third-party
Banyan Vines Mail	○	Third-party	Option	Third-party	Third-party	○	Third-party	●	N/A
DEC VMS Mail	Third-party	Third-party	Option	Third-party	Third-party	●	○	●	Third-party
Wang Mailway	Third-party	Third-party	Option	Third-party	Third-party	○	○	○	Third-party
Others	UUCP	None	QuickMail, VoxMail, Network Scheduler	3+Mail	None	None	AppleLink	UUCP	Mac Vines Mail
SUPPORT									
On-line help	●	●	●	●	●	●	●	●	●
Support line (800# or toll call)	Toll	800#	800#	800#	Toll	Toll	800#	Toll	Toll
Telephone-support policy	Unlimited	3 years	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited[2]	Unlimited	Through VAR/dealer
On-site training available?	●	●	●	●	○	Through VARs	●	○	●
Site license available?	●	●	●	●	○	○	●	●	○
PRICE	$695.25 for DOS users; Mac or OS/2: $495 per server	$1800 for 10 users; $4500 for 50 users	$995/server w/DOS interface; $1195/server w/Windows, DOS, OS/2 interface; $195/NewWave user	$295 for 8 users; $695 site license	$1329 for 20 users	20-user InBox license $329; 50-user DOS Administrator: $995; 50-user Mac Administrator: $995	Single-server: $295 for six users; $695 for 150 users Inter-Network version: $995 per server[3] Additional interfaces: $595 per server	Mac: $499.95 for 10 users; DOS: $469.95 for 10 users	$995 per server

[1] DOS front-end software requires running document conversion utility to attach text files.
[2] Support contract required for gateway assistance.
[3] Inter-Network Courier is required for multiserver or inter-LAN connections. Server licenses include one user interface.

If the West Coast office uses a different type of mail system, you need to have a gateway to translate between the two message formats. The gateway's task can be as easy as rearranging the headers from one format to another, or it may require parsing through gobs of ASCII messages and prompts. Consumers Software and cc:Mail offer many such gateways as extra-cost options.

You may also need a gateway if you do business through commercial E-mail services, such as Western Union's EasyLink or AT&T Mail. The gateway collects outgoing messages and calls the E-mail provider periodically to send and receive messages. Some services also provide their own gateway software that routes

E-Mail Under Unix

Ben Smith

Unlike the PC and Mac world of E-mail, Unix E-mail standards are consistently well established. For the most part, you can send mail messages from any Unix machine and successfully deliver them to any other Unix mailbox. The major differences among Unix mail systems lie in the user front ends and mail routers.

All Unix systems have the simple `mail` front end or a somewhat enhanced version of this line-oriented mail posting and reading program, such as `mailx`. By the nature of mail-routing systems, all Unix mail systems let you post mail to more than one recipient at a time. You can group several people under a single name, and the mail system properly distributes a copy to each. You can "alias" an address to simplify sending mail to your more common recipients. These are standard functions.

The most valuable enhancement on any mail front end is the facility for managing *folders*, the separate subdirectories or files of correspondence for each user with whom you communicate. With this facility, you can easily follow the separate threads of hundreds of conversations.

The second most valuable enhancement is the addition of an *alias manager*, a utility for capturing full E-mail addresses of correspondents and giving them a single simple name to which you can direct E-mail.

The next level of enhancement is implementations of E-mail that take advantage of the screen or window operations of your terminal or workstation. There is no doubt that fast, well-organized, menu-driven interfaces make using any program more enjoyable and easier to learn.

A fine example of an advanced front end for Unix mail is `elm`, a freely available program written by Dave Taylor while working at Hewlett-Packard. (It's available on BIX under unix/listings as elm2.arc?; see page 5 for details.)

Unix Mail Routers

Unix systems often have several kinds of simultaneous connections to other systems, such as asynchronous serial, X.25, and Ethernet. Additionally, most systems have more than one user. When you send a postcard or letter at the post office, you aren't concerned about what kind of truck or airplane your mail is to be carried on. Likewise, when you send E-mail, you need not concern yourself about what kind of connection your Unix system establishes to the recipient's computer; that's the work of the mail router. The three most common Unix mail routers are `smail`, `sendmail`, and MMDF (Multichannel Memorandum Distribution Facility).

The `sendmail` system is both a mail router and a delivery agent (the program that actually posts the mail using SMTP or UUCP [Unix-to-Unix copy]). Eric Allman developed the `sendmail` program while a student at Berkeley. At the time, Unix networking and E-mail were not standardized. The program evolved as the standards evolved. Although there is an underlying design concept to `sendmail`, it grew in a haphazard way, without any plan of what it would become. It's flexible but also unnecessarily cryptic. Because of the way it was developed, `sendmail` had several security weaknesses, one of which was exploited by the infamous Internet worm. Even though it's a first-generation mail router, it's still the most widely used.

To alleviate the pain of `sendmail` installation and administration, some concerned programmers developed `smail`, a simpler mail router/delivery system. Unlike `sendmail`, which derives its method of operation from a complex description of hierarchical rules, `smail` uses tables (some of them standard Unix tables, such as `/etc/hosts`) to derive the information for routing (actually the same connection and `aliases` tables that `sendmail` uses). One attribute of `smail` is its ability to use the Usenet map files to find the least expensive connection path to other machines through intermediates.

Like `sendmail`, `smail` can be both the router and the delivery agent. Many sites combined `sendmail` with `smail` to achieve the multiple delivery agents of the former with the simplicity of management of the latter. Now, however, there is version 3, a complete rewrite of `smail` by Ronald Karr and Landon Noll (who rewrote it while working at Amdahl). This version is fully configurable. You can add your own delivery agents, and it will drop right in in place of `sendmail` without any alteration other than killing the `sendmail` daemon. It can use many kinds of databases, including NIS (Network Information Services—formally known as the Yellow Pages). It also includes a smart kernel that facilitates upgrades of both the source tables and the kernel on a running network.

The MMDF mail-handling system is distributed with SCO Unix. Although it's not as widely used as `sendmail`, it's easy to verify the security of a system that uses MMDF because its operations are determined by its own database structure. The design of MMDF follows a common database paradigm: a prescribed file (the "database dictionary"), which defines the domains and programs that the MMDF system uses. Each of the subordinate tables follows a consistent format. It's relatively easy (once you have learned the structure) to add new delivery routes and devices. It's also possible to combine an MMDF-based mail system with a fax driver to generate outgoing faxes. But MMDF won't just replace a `sendmail`-based system. The databases are completely separate from any other tables describing network connections. The MMDF tables must have separate explicit descriptions of every possible method of addressing a connection, and creating these entries is far from automatic. New releases of MMDF will alleviate some of these shortcomings and will also be able to use the Usenet maps for determining explicit paths.

Other Systems

Other E-mail packages are available from the major vendors. Many of them, including those from Sun and Next, use `sendmail` as the router. They may include some enhancements for attaching files that contain graphics and sound.

Few, as yet, include X.400 delivery mechanisms, but since that is the future common standard for all heterogeneous mail systems, this E-mail standard will probably be implemented this year.

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messages between LAN-based E-mail systems by way of the E-mail service.

The international E-mail interexchange standard, X.400, is so complex and costly to implement that currently only large enterprisewide networks and commercial E-mail service providers use these gateways. Action Technologies' Message Handling Service is less sophisticated but more widely implemented in smaller workgroup environments that need to interconnect dissimilar E-mail systems. MHS runs on a dedicated file server. Novell includes a copy of MHS with NetWare. Most of the E-mail vendors offer gateway software as an option that runs in conjunction with the MHS server.

The Arena

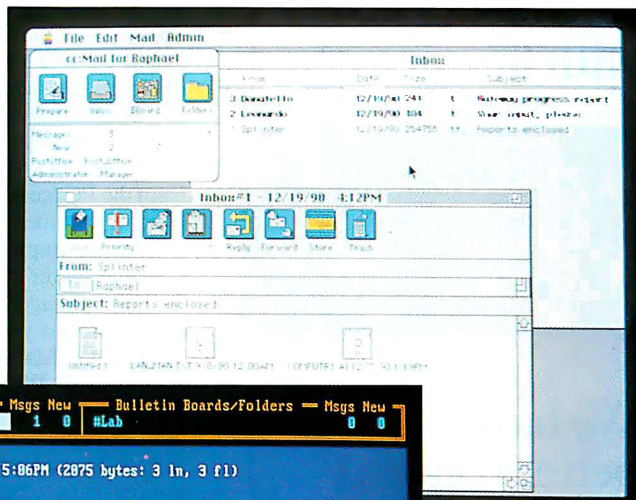
We concentrate here on nine best-selling packages that run on a variety of systems and networks. Most of them support Action Technologies' MHS, the current standard on PC LANs for exchanging messages between dissimilar E-mail systems (see the text box "MHS Gets the Mail Through" on page 231). Enable Software's Higgins Mail, Action Technologies' The Coordinator, and Da Vinci Systems' eMail run only on PC LANs. The rest of the packages we tested—cc:Mail, from cc:Mail, Inc.; The Network Courier, from Consumers Software; Sitka's InBox Plus; Microsoft Mail; and CE Software's QuickMail—support mixed DOS and Macintosh environments. If you can get your machines to share files, you'll be able to share E-mail, too.

Banyan Systems' Network Mail for Vines didn't meet our criteria because it works only on Vines networks, but it has a following among Vines users. We discuss it in the text box "Banyan's Network Mail for Vines" on page 234.

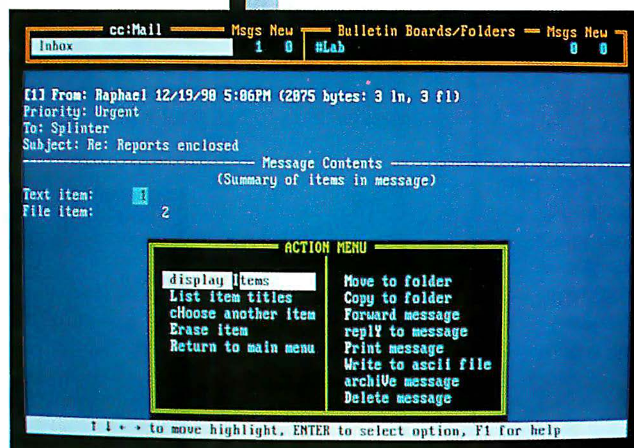
We put these nine E-mail packages to work on three test networks. We used a LocalTalk PC card and interface software to connect a 386 clone running DOS to our AppleShare network. We also tested all the E-mail packages on PC LANs running Vines and NetWare.

None of the packages was particularly easy to install or maintain. You should consider E-mail software to be in the same class as file-server software. Your network administrator should install it, set up the user lists, and get the bridges connected. A system administrator should be able to easily manage any of these E-mail systems, but for large installations that require gateways, help from an experienced installer is invaluable.

cc:Mail 3.15



Screen 1: (a) *The Mac version of cc:Mail sports an intuitive interface. Icons in the lower window denote attached files.*



(b) *Reading mail with cc:Mail under DOS. While the DOS version lacks the Mac version's icons, choices are clearly indicated and straightforward.*

The cc:Mail package comes in DOS, OS/2, and Mac versions and offers optional gateways to many other E-mail systems. cc:Mail uses your network file server to provide mail services. It encrypts messages and stores them as data files on the server's hard disk. Installation and administration aren't easy. There's no installation program—just a fat administrator's manual full of instructions.

A PC needs an AppleTalk-compatible network card and the appropriate network connector (in our case, LocalTalk) to access an AppleTalk network. We used an Apple LocalTalk PC card connection to add a 25-MHz 386 PC to our Mac network. The card's AppleTalk software provides services for printing and remote file access. These services are memory hogs, taking from 107K bytes to 170K bytes of RAM, depending on the network services you use. However, the card allowed us to place the data files in a folder on our AppleShare file server.

On the Mac, a desk accessory (DA) provides notification services, and an application manages your mailbox. When you first launch cc:Mail, you use a Standard File dialog box to locate the mail files on the server; cc:Mail then creates a Post_Office file. Once you've done this, from then on you simply double-click on this file, which launches cc:Mail, and information (i.e., the path to the server and your user name, stored as STR resources) in this file helps establish the connection. It feels a bit kludgey, but it works.

PC users run the Mail and Notify programs to manage their mailboxes and to install a TSR program that alerts users to incoming messages. The Messenger program also provides notification and sets up Alt-2 as a hot key to access mail services from DOS. When you run each of these programs, you must supply the mail directory's path, your mail name, and your password. cc:Mail should remember the message directory path: Users will be tempted to build a batch file to supply the path and other information, but this may compromise the security of their mailboxes. Under Windows 3.0, a postage-stamp icon of a minimized Notify program lets you list the messages in your mailbox and can switch you into cc:Mail.

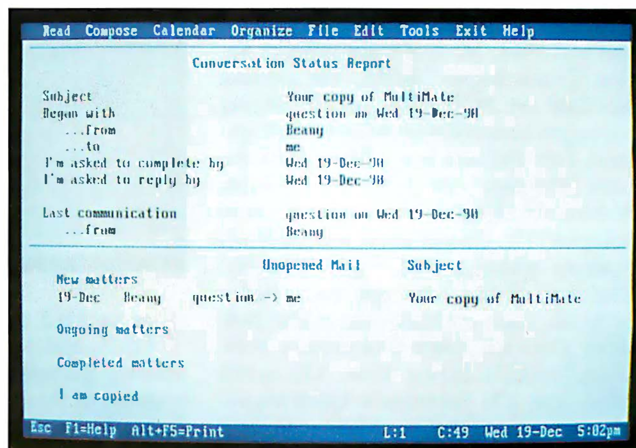
The Mac interface is simple and clean and makes good use of color. Of all the Mac E-mail packages, this one had the best interface. Various icons represent buttons that you click on to provide mail services such as reading, composing, and deleting messages. Each button has

an equivalent menu selection, and highlighted mail entries open with either a mouse-click or a press of the Return key. Enclosed files appear as document icons in a daughter window, and double-clicking on them lets you view the file's contents. You can view graphics files sent from the PC (cc:Mail saves them in PICT format), but the color mapping from PC to Mac is imprecise. The Notify DA polls the server at user-defined intervals for new messages. A small window or a chime informs you of mail waiting.

The DOS Mail program is a tad more complicated. While prompts attempt to guide you through mail operations, it's not always clear what you should do next. A built-in graphics editor lets you draw images that you can send with a message, and the Snapshot TSR lets you capture and send screens from any application. The Messenger TSR offers a convenient way to check your mailbox. cc:Mail can run as a DOS application in Windows 3.0's enhanced 386 mode, but it's slow because it has to run as a virtual process. Mail transfers between the different computers were painless.

Users of cc:Mail who are interested in sending voice-mail attachments can buy VoxLink's VoxVoice (software, $2000) or VoxMail (hardware and software, $5000). Users call the voice-mail server to record messages, which they then attach to cc:Mail messages. The VoxLink products work with both cc:Mail and The Coordinator, using their native mail formats.

The Coordinator 2.1



Screen 2: *The Coordinator treats messages as a complete conversation thread.*

The Coordinator's underlying engine, MHS, has become a de facto standard for exchanging messages between dissimilar E-mail systems. The package also includes a calendar and a group scheduler, but we'll concentrate here on its E-mail capabilities.

Most of the other mail packages seem to follow the letter and envelope metaphor, where you write text and stuff it in an envelope with file enclosures. When you receive mail, you send a reply and then delete the original message. The Coordinator treats your messages as part of an ongoing communication thread, automatically grouping messages into "new," "ongoing," and "completed" classes. You create a new message thread each time you create a mail message. The Coordinator links each reply as part of an ongoing message. To help things along, the message editor lets you specify your reply as a Question, Offer, Request, or some other form of verbal communication. The other packages we reviewed use common paper metaphors, such as "While You Were Out."

Because messages are linked, The Coordinator also provides utilities to display the messages in context. History features let you see an entire communication thread at once. You can also choose to view messages by type, looking at only the "Questions" or maybe just the "What Ifs."

No mail package would be complete without file enclosures. The Coordinator lets you attach only one file per message. We found that a bit limiting.

We disliked just a few things about this package. The limit of one file attachment per mail message is a minor annoyance. More serious is the Coordinator's inability to alert you to incoming messages. All the other packages beep or interrupt your current application with an alert message. With The Coordinator, you've got to run the package periodically and do the checking yourself.

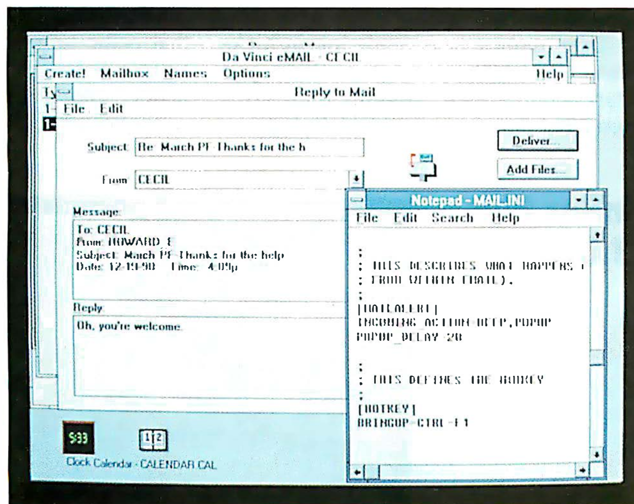
Finally, the user interface is somewhat awkward. When you start The Coordinator, the opening screen shows a list

of your current messages broken down by classification. You open a message by moving the cursor to it and pressing the Return key. A new window pops open, but, unfortunately, the cursor isn't there. In order to scroll through the message text, you must manually change to that window. The F5 and F6 keys switch between windows, or you can use the Scroll Lock key to modify the operation of the cursor.

IBM intended the Scroll Lock key on the PC to constrain the cursor from moving off the page of a document. But no one ever programs it this way. Usually, the Scroll Lock key is left undefined because no one knows what to use it for. Action Technologies set up the Scroll Lock key so that when you enable it, the up-arrow and down-arrow keys can scroll only the text within the current window. Pressing the key to disable Scroll Lock allows the cursor to leave the current window and move to the next one. Of course, once you're in the new window, you can't scroll until you reactivate Scroll Lock. It felt awkward to use the key the way it was intended—perhaps that's why no one else does.

Other keys are inconsistent from screen to screen. When you're selecting a message to operate on, for example, the Delete key deletes (or marks for deletion) the message. If you're composing a new message or reply, the Delete key opens up the addressing window.

eMail 1.07



Screen 3: *Da Vinci Systems' eMail running under Windows 3.0. The MAIL.INI file lets you customize eMail to your tastes.*

Da Vinci Systems offers versions of eMail for DOS, Windows, OS/2, and NewWave environments. The DOS interface uses control keys, and if you forget what to press, the F8 key brings up options. Besides that, the screen is essentially blank and offers no obvious hints. The addition of a few messages to the DOS screen would make eMail easier to use. The Windows version is cleaner and puts the functions where you'd expect them. It was necessary to read the manual to figure out the DOS version.

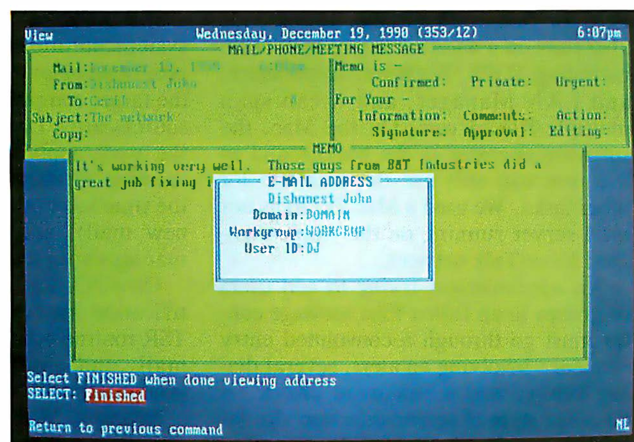
eMail lets you attach files to messages. Under Windows, you can send the contents of the Windows Clipboard to other Windows users. You copy something to the Clipboard and attach it, and the recipient pastes it into an application.

Security-conscious administrators may have a problem with eMail. Message files are easy to locate on the file server and remain unencrypted unless the sender specifically requests encryption. If you encrypt a file, the message sits on the server in unreadable form, and the recipient must type a password in order to accept the message.

Users have personal information files that define how eMail operates on their systems. They can change the polling frequency for incoming messages and the alert procedure, and they can customize their message alert sounds by changing the MAIL.INI file. The latter procedure makes it easier to tell whose machine received mail in offices where machines are closely grouped. We configured one of our machines to play reveille. That sounds like an obvious idea, but none of the other packages do it.

DOS users can run eMail as a standalone application or as a TSR program. The "micro TSR" format uses a swap file and takes up only 10K bytes of RAM. You define a hot-key sequence that swaps out your current application and loads eMail. When you exit eMail, it restores the interrupted application where it left off. Alerts can come through the Novell Send mechanism, or you can load a TSR that presents a one-line message at the bottom of the screen. Windows alerts will appear for a definable amount of time (the default is 20 seconds) and then disappear.

Higgins Mail 2.3



Screen 4: *The simple and efficient layout of Higgins Mail. Note the extended addressing capabilities that support E-mail over wide-area networks.*

Higgins Mail is the E-mail-only version of Enable Software's workgroup scheduler software. It runs on DOS and OS/2 machines.

Unlike The Coordinator, Higgins presents E-mail as an electronic version of slips of paper. We ran the user software on both NetWare and Vines without any problems. The administration software is heavily based on an ASCII menuing system that proved to be too large for the Vines workstations. Running the administrative menus resulted in an "insufficient memory" message.

Higgins Mail uses a shared database on the file server. The file structure is proprietary, and the message files them-

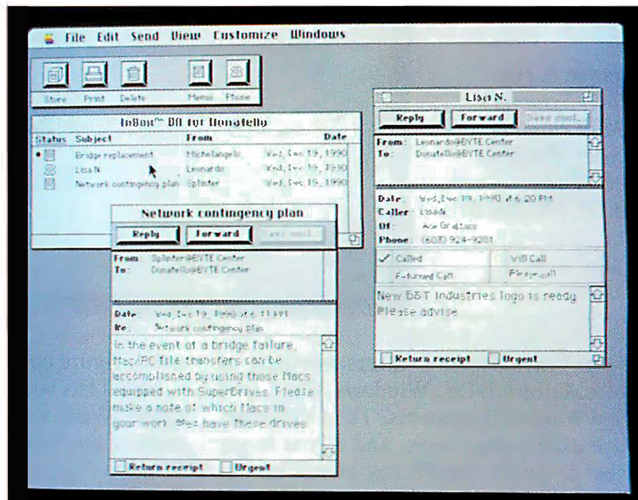
selves are encrypted. Because of Higgins Mail's popularity, a number of gateways exist to move messages between Higgins Mail and other E-mail systems.

As you move around the Higgins Mail screens, help messages at the bottom of the display change. The command structure feels a lot like Microsoft Word—it uses the same Escape-letter interface. You press Escape to get to the menu at the bottom of the screen and then press the appropriate letter. Choosing an edit function removes the menu, and pressing Escape moves you from the editing window to the menu again.

User names have both log-in/nicknames and full user names. When you start sending mail, Higgins Mail gives you a list of users in the default domain. A domain consists of people, resources, and mail groups, and you can freely switch from one list to another and pick the recipient name(s) off the pick list. The names are specified by Domain:-Workgroup:User ID, much as the StreetTalk global naming service does for Vines.

Mailcall alerts Higgins Mail users to their incoming mail. This 3.5K-byte TSR program brings up a message for 10 seconds or until you clear it manually. If you don't read your mail or clear the message, it will reappear periodically. Several other DOS packages have alerts that come up once and then disappear. Enable Software's method works much better, and it does it with very little memory.

InBox Plus 3.0



Screen 5: *InBox Plus has built-in memo and phone message templates.*

InBox Plus provides E-mail services for PC or Mac users. Optional gateway software lets you send messages to systems running Unix Mail, Vines, and others. InBox Plus's strength is its device independence: InBox Plus E-mail servers, or "message centers," can be Macs, PCs, or Sun workstations. InBox Plus also runs on a wide variety of networks, including TOPS, NetWare, AppleShare, and LAN Manager, and it can span multiple file servers. On the Mac, the software operates in the background so that you can still use the machine for other tasks. We used a Mac SE/30 as our mail server running on the Apple standard LocalTalk network.

An administrator trying to add users or groups to an InBox Plus message center must go through a convoluted entry sequence involving an alert, several dialog boxes, and a password check. A Chooser style of server selection similar to Microsoft Mail's implementation would make selecting a message center easier. By using the administration software for a PC-based message center, however, we were able to add mail users to a message center on the Mac. InBox encrypts and stores messages on the mail server's hard disk.

InBox Plus users have it easier than the system administrator: An installation program copies the necessary resource to the target computer. On a Mac, these resources are a DA (used to swap between the mail application and the currently running application), a cdev (used to set the time interval for notifying you about new mail), and an application (which manages your mailbox).

On a PC, a setup program sets the notification interval and other options. A TSR routine provides notification of new mail, and another program manages your mailbox.

When a Mac user receives mail, a chime sounds and a Notification Man-

MHS Gets the Mail Through

Before Action Technologies introduced its Message Handling Service, there were no workable interexchange standards in the LAN E-mail world. Bundled with every copy of NetWare, an MHS gateway requires its own dedicated server and is a convenient way of moving information between E-mail systems. Because of widespread support for MHS, the product has become the least common denominator for interconnecting workgroup E-mail systems.

MHS provides a standard structure on the file server where your mail application can drop off messages; it puts the incoming messages in specific locations and manages the physical flow of messages between mail centers. When you install MHS, you create a structure in a publicly accessible spot. Anyone on the network can create a message packet and drop it in the MHS *in box*. Once you've created the message, the MHS utility software grabs the message and then processes it.

A standard MHS packet is an ASCII file containing several vital pieces of information. A version number (65 for MHS 1.2) tells MHS that this is an MHS mail packet. The next line has the "To:" field, and the following line has the "From:" field. Your E-mail front end is responsible for handling the addressing and providing complete MHS addresses.

If you have addressed the message to a user on the same MHS server, the server simply copies the file to that user's MHS mailbox. Periodically, an MHS E-mail front end has to poll the mailbox, looking for new messages. When it finds one, the software copies it from the MHS mailbox to the E-mail mailbox. If the address is for another mail center, MHS moves the message to an *out box* for further processing. At some time that is determined by the MHS *scheduler*, the server picks up the outbox mail and sorts it by destination. It then establishes a connection to the mail center and transfers the messages to the remote MHS site.

The remote MHS server then picks up and sorts the messages by address. From this point on, it's the same as if the mail were sent within the LAN. As far as a user at the remote site is concerned, the only difference is that the mail takes a bit of time to arrive. The E-mail software doesn't know about gateways or bridges: It just puts an address on the mail and sends it out. MHS takes care of the dirty work.

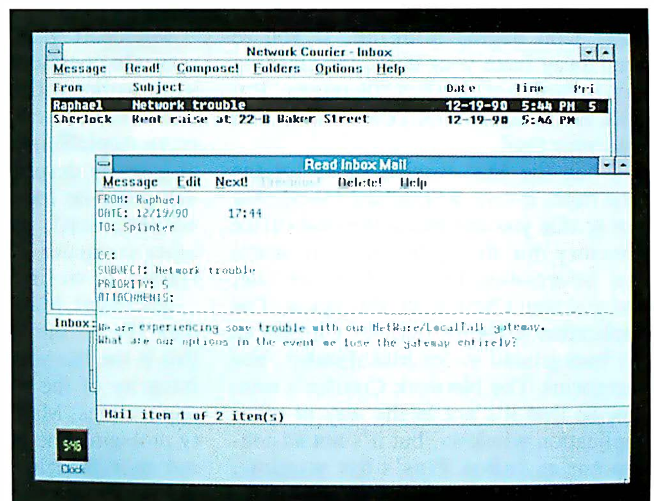
MHS server gateways work differently from other E-mail gateways. The MHS scheduler can execute programs as part of the scheduled process. These programs are usually file converters or message formatters, much like the ones the gateway software would use in some other mail program. MHS defines a gateway as one of these special programs and can dispatch it to each message in the in box.

---

ager icon blinks in the Apple menu. If you're using MultiFinder, you can let the InBox Plus application run in the background, which leaves a small, movable "hot window" when you switch to another application. Clicking on this hot window gets you back into InBox Plus, where you can read, delete, store, and print letters. Templates for memos and phone messages are built in. Several buttons with icons let you select certain operations (e.g., printing, deleting, composing new mail, and enclosing files) rapidly.

On the PC, you get a "crawler" message across the top of the screen stating who sent you mail. It moves across the screen once and sounds a chime, but it won't reappear if you miss it. The menu layout resembles the Mac's, and you use the Tab and Alt keys to navigate through the menus. Copious use of function keys takes the place of Mac buttons. This provides a consistent interface that lets you quickly read and write letters on either platform. However, there are differences. On the Mac, a paper-clip icon indicates that a message has an attached file; on the PC, an ampersand appears next to the message. Finally, InBox won't erase letters marked for deletion until you exit the program, so you can recover accidentally deleted messages.

The Network Courier 2.1



Screen 6: *The Network Courier's Windows 3.0 interface isn't fancy, but it works well—especially its Monitor feature.*

The Network Courier provides E-mail services for DOS, Mac, OS/2, and Windows users. Consumers Software also offers an extensive array of gateway options for interconnecting diverse computing environments.

Users exchange messages through virtual "post offices" that can in turn exchange messages. The Network Courier relies on the file services provided by network file-server software, such as NetWare, LAN Manager, and Vines, to operate.

The Network Courier includes a scripting language for writing programs that access, send, and receive messages from other on-line services via modem. Optional gateway software provides access to other mail systems, such as DEC VMS mail and MHS servers. Messages reside in subdirectories on the network's file server. The program uses the Department of Defense's Data Encryption Standard scheme to protect messages.

The Network Courier's install programs place data files and PC software

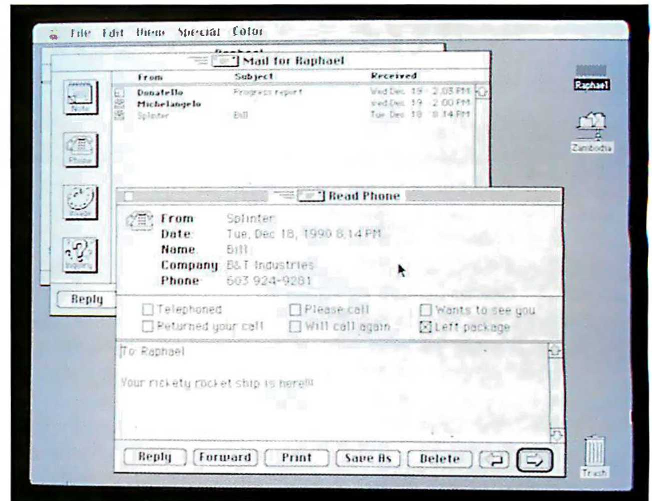
in the appropriate directories on the file-server hard disk; to install Mac mail, you simply copy a single application to the workstation's hard disk.

Program modules include a PC administrator; a mail program that lets you read, write, and print messages; and a TSR program that notifies users of incoming mail by polling their mailboxes. The Escape key, arrow keys, and highlighted characters enable you to maneuver through the programs adequately. Short, explanatory messages appear as you move through menu choices. Messages can have an unlimited number of attachments. As with cc:Mail, you have to supply the path to the post office's directory.

For Windows 3.0 users, a single program does double duty as a mailbox manager and notification service. Short help messages appear as you move through the various menu options. You can switch to "monitor mode," which shrinks the application's window to a letter icon. In this mode, the application takes up less than 10K bytes of memory but continues to poll your mailbox for new mail (you can change the polling interval only by modifying the Windows WIN.INI file). When a new message arrives, The Network Courier chimes, the mouse pointer briefly turns into a letter icon, and the letter icon begins blinking. If you've been away from your desk, the flashing icon is hard to miss when you return. You click on the icon to open the window and read your mail.

When the Mac version starts for the first time, it uses a Standard File dialog box so that you can locate the post office directory for the application. It stores this information in a Preferences file, and you won't have to do this again. The application polls for mail by running in the background under MultiFinder. You can shrink The Network Courier's window so that it's not in the way of other application windows, but it's not as convenient as InBox Plus's hot window. When a message appears in your mailbox, The Network Courier uses the Notification Manager to flash the Apple menu icon, and an alert box appears when you switch The Network Courier to the foreground. When sending messages, you can attach files and assign priority levels from low to urgent to them. The Mac interface needs some polish: The order of some of the buttons seems odd, and highlighted messages don't open with the Return key press. Consumers Software has a new Mac version in the works that should correct some of these problems.

Microsoft Mail 2.0



Screen 7: *Microsoft Mail, displaying a phone message on the Mac. The Image button lets you mail the Clipboard's contents to another Mac.*

This package spans both PCs and Macs but runs only on AppleTalk-compatible LANs. Microsoft Mail also requires a Mac to provide E-mail services. For this review, we pressed a Mac LC into use as our mail server.

An installer application copies an INIT to the Mac that's to become the mail server. This INIT code installs a driver that supplies background mail services. Because the driver operates in the background, the Mac is able to function as both a mail server and a workstation.

Microsoft Mail doesn't require a file server to operate, but since the mail software works with AppleShare, it's safer and more secure for these services to run on an AppleShare file server. An optional gateway development kit lets you develop add-on modules that can dial up, connect, send, and receive mail from other computer systems, such as mainframes, or on-line services.

Microsoft Mail stores messages in a data file on the server's hard disk, and this is the file you back up to protect the integrity of the mail system. For some applications, Mail has a potential security problem. The messages in this file are not encrypted; a sharp person with access to the mail server and a disk editor utility would be able to explore this file to locate and read messages. If you want your mail to be safe, you must secure access to the mail server.

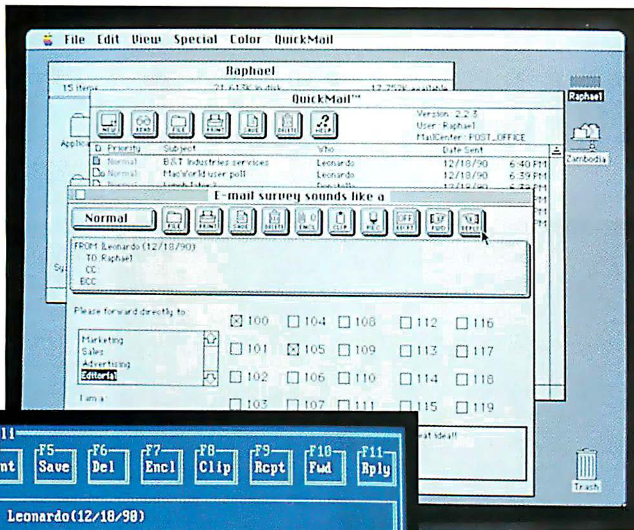
A workstation Mac uses an INIT/RDEV file in the System Folder and a DA to access mail services. The INIT installs a driver that provides notification services. As an RDEV, the file shows up in the Chooser DA and lets you pick different networked mail servers. The DA lets you read your mail, write letters, and manage your mailbox (by deleting or forwarding mail). Certain applications have software "hooks" into Microsoft Mail so that you can send the document you're working on or read mail via a File menu selection without bringing up the Microsoft Mail package. Naturally, Microsoft's Excel 2.2 and Word 4.0 provide this feature, but so do such applications as Aldus's PageMaker 4.0 and Aladdin's StuffIt Deuxe 1.0.

On the PC, a TSR program informs you when mail is waiting; another program lets you manage your mail. The simple, Spartan interfaces of the Mac DA and PC mail program are similar but not identical. There are templates for several types of mail messages: Note (a letter), Phone (it resembles those phone message slips that pile up on your desk when you're away), and Inquiry (for reporting a problem to the network administrator). A Mac utility application lets you create templates for new mail messages (e.g., purchase orders). On the Mac, you can paste PICT images from the Clipboard into an Image message. You can also enclose files with your mail.

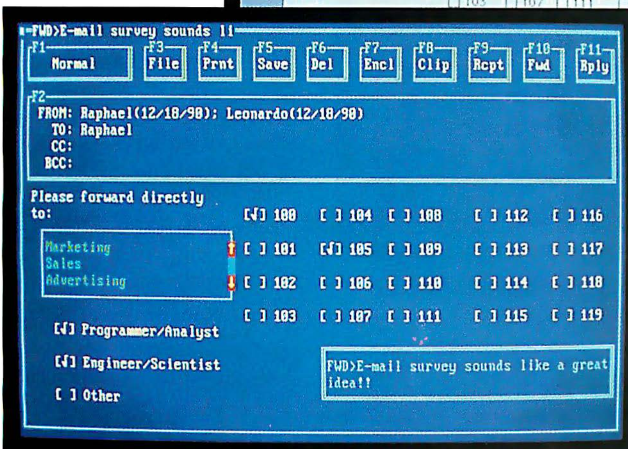
Sending mail messages from Mac to PC and back is easy and reliable. Microsoft Mail normally runs in character mode. We got the PC version to operate under Windows 3.0, but you must create a .PIF file to run it, and the program notifies you of incoming messages with chimes but no visual indicators.

Microsoft Mail is the Volkswagen of E-mail products: It's not fancy, but it gets your mail from one system to another with a minimum of fuss. If you want your messages kept private, however, the lack of message encryption is a serious flaw. Microsoft has released version 3.0 of Mail since we conducted this review. We'll report on it in an upcoming issue.

QuickMail 2.2.3



Screen 8: (a) *QuickMail uses a custom message template built with the Forms utility. Templates can use Mac dialog elements, such as check boxes and scrolling.*



(b) *As shown here, forms generated on the Mac reproduce using QuickMail on the PC.*

Like Microsoft Mail, QuickMail supports Macs and PCs but requires a Mac server and an AppleShare network. QuickMail was the only package we tested, except for Network Mail for Vines, that supports real-time conferencing—a handy feature. It's also one of the few packages to support voice mail.

QuickMail's Mac software loads as an INIT and installs a quick-access menu in the menu bar. Installing the user software is incredibly easy. The character-based DOS software doesn't mind running from a .PIF file under Windows.

Public messages appear as a BBS of sorts. Anyone on the network can read messages addressed to "public," but only the message creator or the administrator can delete them. We'd like this feature even better if QuickMail would let administrators assign expiration dates for public messages.

You create a new message by selecting the appropriate form. Standard forms are memos, notes, and "While You Were Out," but you can use QuickMail's form designer to create your own. Forms include a collection of check boxes, text objects, and, on the Mac, bit-mapped graphics. You draw a new form and then install it with a menu choice. Even better, if you attach the form as a mail message, the recipient's machine can automatically install it as soon as it arrives. It's a handy way to move new forms from one place to another.

Before you send a message, you must choose a priority level. QuickMail uses priority levels primarily for sorting messages, but the Urgent messages serve a special purpose. The DOS user interface has a separate alert for Urgent messages, and any messages sent through a gateway bypass the gateway's standard batch mode schedule and are sent immediately.

We expected the DOS software to be harder to use than the Mac software. Boy, were we wrong. CE Software has laid out the buttons in the same configuration as the Mac version and has defined the menus in the same way. Even the forms defined on the Mac translate directly to PC screen format. Mouse support on the PC is limited, and we found ourselves using the function keys most of the time. As a mimicry of a Mac interface, it's the best we've seen on a character-based screen.

On both platforms, incoming mail or conference activity automatically brings up the mail package. That can be a little disconcerting at first, and you can disable this function if it bothers you. Conferences display a multiwindow screen. One window shows the list of participants and lets you selectively target messages. A second screen shows the conversation thread; the third shows your input. We found conferencing to be one of QuickMail's strongest features, and one we'd use.

The only bug we found has to do with multiple registrations. When we set up a conference between Macs, we'd occasionally see one of the Macs appear on the registration list more than once. The Refresh menu option cleared this up, but it shouldn't have happened in the first place. The PC software didn't have this problem.

One last feature that you may find interesting is voice mail. Using a Farallon MacRecorder, you can digitize a voice message and attach it to your mail message. Anyone receiving the message on a Mac can play the message back. The feature is fun, but we wonder if it has much practical value.

The performance of our Mac LC, which did double duty as a mail server and a workstation, wasn't affected significantly, despite heavy mail-server activity. Still, we'd recommend that any installation with heavy mail-server activity use a dedicated machine. Dedicated servers aren't as likely to crash from broken applications software. Also, QuickMail can share a machine with your AppleShare server—a great way to get the most out of your dedicated file server.

Connecting remote mail sites requires that you run a modem from the server's modem port. We chose to set up the QuickMail server as a workstation and wanted to get the Telecom bridge running on the server. The manuals aren't clear on all the details, and we found ourselves spending several hours on the phone with CE Software's technical support.

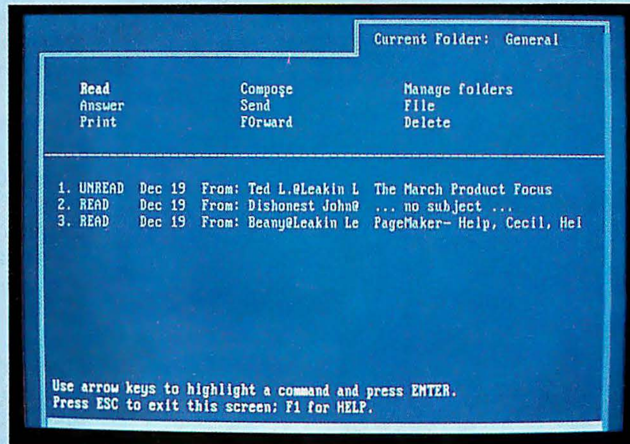
We finally managed to use the generic gateway to grab our mail from BIX and route it to our QuickMail mailboxes. *Aliasing* is a way of having mail sent to one user name forwarded to another name. For example, if Theodore Logan wants to be known as "Ted," the aliasing functions provide for that. Getting the aliasing to divert the mail correctly under all circumstances would have taken a bit more time than we were willing to spend.

Do You Need E-Mail?

Maybe, and maybe not. According to the vendors of the packages we reviewed, everyone in the office needs E-mail. One

Banyan's Network Mail for Vines

Banyan's Network Mail for Vines 4.0 is an optional package that provides E-mail services to PC users on a Vines network. Network Mail can be part of a complete network installation, or it can be added to an existing Vines network. Each server on the network requires its own copy of Network Mail. Vines operates on top of the Unix kernel, using the multitasking capabilities of Unix to manage various services and provide security for the message files, whose contents are unencrypted.



Screen 9: *Network Mail for Vines has the same easy-to-use interface as the other Vines Network utilities.*

We used a Compaq Deskpro 385/25e as the Vines network server. The Unix-based operating system is large and has a lengthy installation sequence. Fortunately, Network Mail installs with the rest of Vines; you just reboot the computer, enable the mail service, and you are in business.

Network Mail is copy protected: During installation you must plug an "option key"—a small module with a printer connector—into the server's printer port. From the server's operator screen, you then instruct the computer to install the option. Vines updates information in the option key. Then you remove it, select the hard disk that Network Mail should use for storing messages, and then start the program. After that, any Vines users can access mail services by running the Mail program.

Administration is easy, and you can provide different services to mail users. For example, you can restrict some mail users from attaching DOS files to messages.

The character-based menu screens that Network Mail uses are simple and designed to work across the widest range of PC monitors. Once you master the idiosyncrasies of the Network Mail interface, the program is easy to use. You choose operations (termed *functions*) by using the arrow keys or typing the function's first character. The Escape key backs you out of a function into the previous screen. On-line context-sensitive help screens are available at the press of a key.

The message editor lets you read, write, forward, or print messages, and you can attach text or binary files. Vines provides automatic notification of new mail with a chime and a highlighted banner that appears at the bottom of the screen. You can configure the message alert so that the banner disappears after a few seconds, or you can have it remain on-screen until you clear it yourself.

Network Mail uses StreetTalk, Banyan's global directory-addressing feature that provides unique names for network services. StreetTalk provides every network resource, such as servers, printers, gateways, and your mailbox, with a unique three-part name. This means that Network Mail users can address and send messages to a firm in, for example, London, without worrying about how the message will get there. Optional gateways for SMTP, Message Handling Service, and other E-mail environments are available, including one that translates to CE Software's QuickMail.

Because Network Mail is an adjunct to Vines, some comments on the capabilities of the network software are in order. On the downside, Vines makes large demands on memory, consuming about 120K bytes of RAM in your computer. However, you can load 37K bytes of Vines into extended memory to soften the blow of memory consumption.

On the positive side, this memory is put to good use. Designed to manage huge networks composed of hundreds of sites and numerous servers, Vines provides capable network services. For example, we used its NetBIOS emulation service to evaluate two mail packages: cc:Mail and Higgins Mail. Network Mail does not have a chat feature, but Vines does.

Network Mail message transfers were reliable, and the notification service worked without fail. Huge networks with scattered sites would do well with Vines, and the mail service would help tie the sites together.

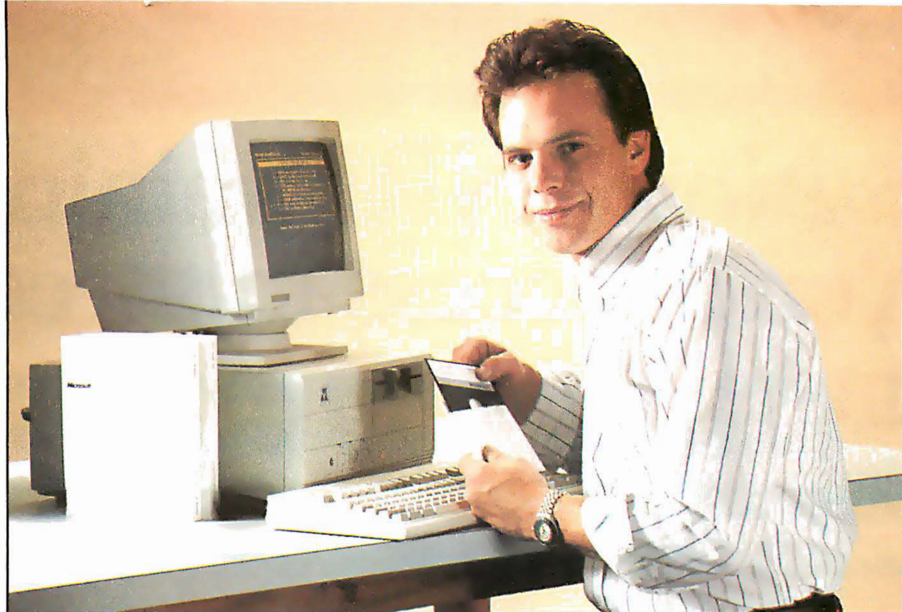
If you're running Vines, Network Mail is the natural choice for you. But if you've got other networks to manage, you may want to standardize on one E-mail package that runs in all environments.

problem: You usually have be in front of your DOS machine when a message is sent to you if you want to catch the mail-alert message. If you don't see it the first time, the mail will just sit in your electronic mailbox until you look for it. Mac E-mail applications that use the Notification Manager do a better job: The Apple menu icons blink until you enter the E-mail application.

Another factor is your office size. In a small group, it's simply not cost-effective to place E-mail software on every computer when a Post-It note or a walk down the hall to someone's office will do. Sometimes low-technology solutions work better than the high-tech ones.

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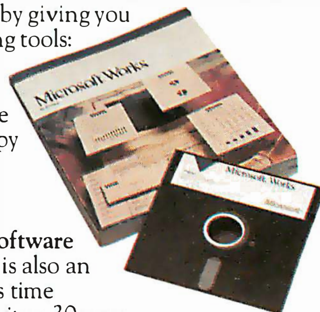
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The Perfect E-Mail Package

In business, good communication can often mean the difference between profit and loss. If you can't get messages to your remote sales staff, rest assured that other companies can reach *their* people. Playing phone tag is frustrating. A good E-mail package effectively bypasses the phone and puts the message right on your contact's desktop. Most of these packages also let you enclose files that contain graphics, a software update, or a lengthy report.

Most E-mail packages aren't cheap. In a small workgroup environment, price may influence your decision. But if you are trying to bridge multiple E-mail systems, computer architectures, and networks, support and training are more critical. Vendors who sell their own gateways are probably better positioned to support your entire E-mail network than those vendors who refer you to third-party products.

During our evaluation, we found that most of these packages had annoying quirks or limitations. Having your E-mail messages sit unprotected on the server can be a problem for some installations. If you decide on Microsoft Mail or QuickMail, you'll want to keep your mail server in a secure place. We'd suggest that you beef up your file server and run either QuickMail or Microsoft Mail as a process on the file server. Lock the server in a secure place, and security should no longer be an issue.

If you're running an AppleShare network, check out QuickMail. The user interface is clean and intuitive. Factor in the wealth of gateways available and the built-in voice mail, and you've got a winner.

Of course, if you are not running AppleShare, you can't use QuickMail. In that case, cc:Mail should do the trick. It's easy to use and has all the features most workgroups will need. cc:Mail's front end was the best of any of the Mac packages. We also liked the built-in graphics editor; PCs are not well endowed with drawing software, and having it right there makes it easy to annotate your messages.

Finally, there is The Coordinator. This is the only package reviewed that treats your messages the way you intend them to be—as part of a communication thread. It runs only on the PC, but you can share messages with Mac E-mail systems through an MHS gateway. The user interface is somewhat obscure, but don't let that deter you.

Neither rain, nor snow, nor stray magnetic fields will keep your mail from getting there. As E-mail becomes more popular, we hope to see a real standard emerge. Until then, it will take some creative effort to forge the connections. Get your network administrator involved early—installing any one of these packages is harder than it looks, especially if gateways or bridges are involved. ■

Howard Eglowstein is a testing editor/engineer in the BYTE Lab. Tom Thompson is a senior editor at large. You can reach them on BIX as "heglowstein" and "tom_thompson," respectively.

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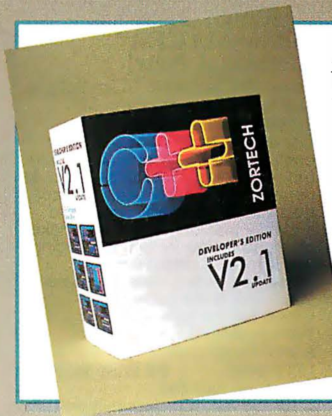
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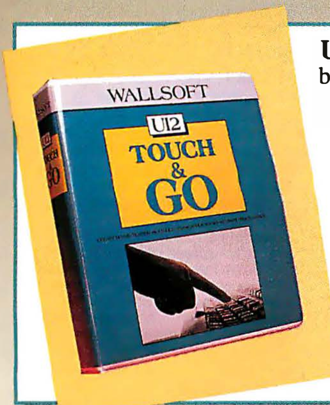
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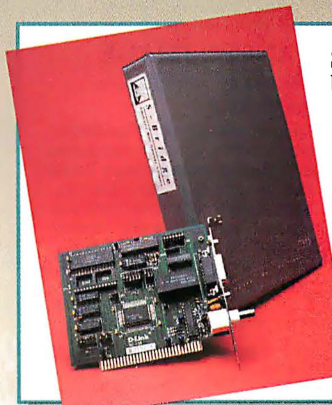
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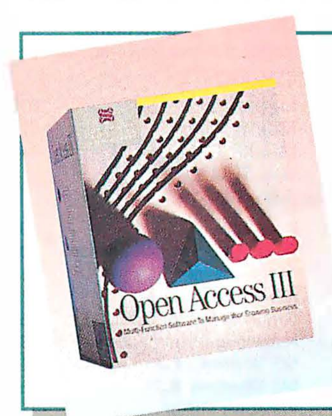


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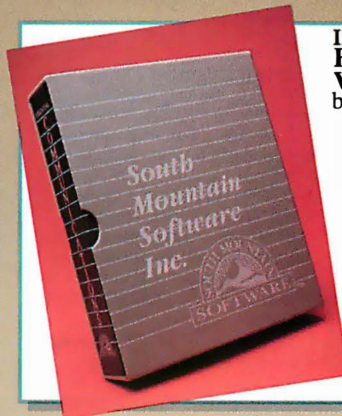
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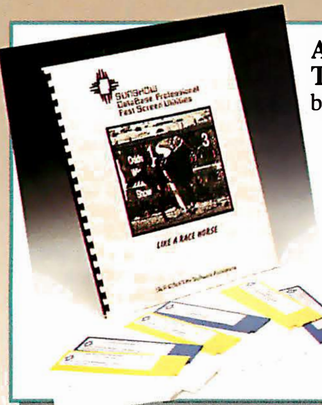
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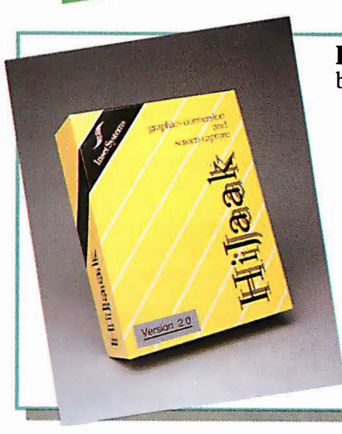
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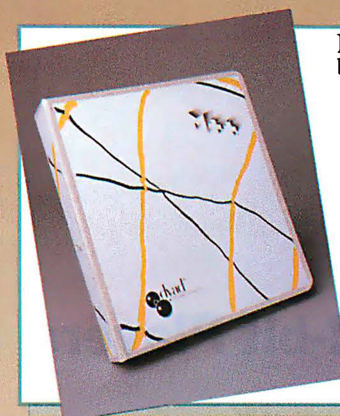
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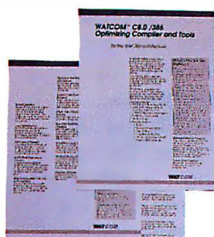


BORLAND C++ 2.0
by Borland International



Borland C++ is the only complete C and C++ programming environment for DOS and Windows. It is Borland's high-end language product targeted at professional developers. Developers can use existing C applications and move to object-oriented programming (OOP) with C++ at their own speed. For the first time, professional developers can take advantage of OOP when writing DOS and Windows applications. Borland C++ includes new features and tools that are designed to take advantage the hardware and software needs of professional developers, including support for 286 processors, megabytes of extended memory, and large hard-disks. Borland C++ is built to increase programmer productivity. Borland C++ also includes Windows development tools. Developers can use this product to create Windows applications without purchasing the Microsoft SDK.

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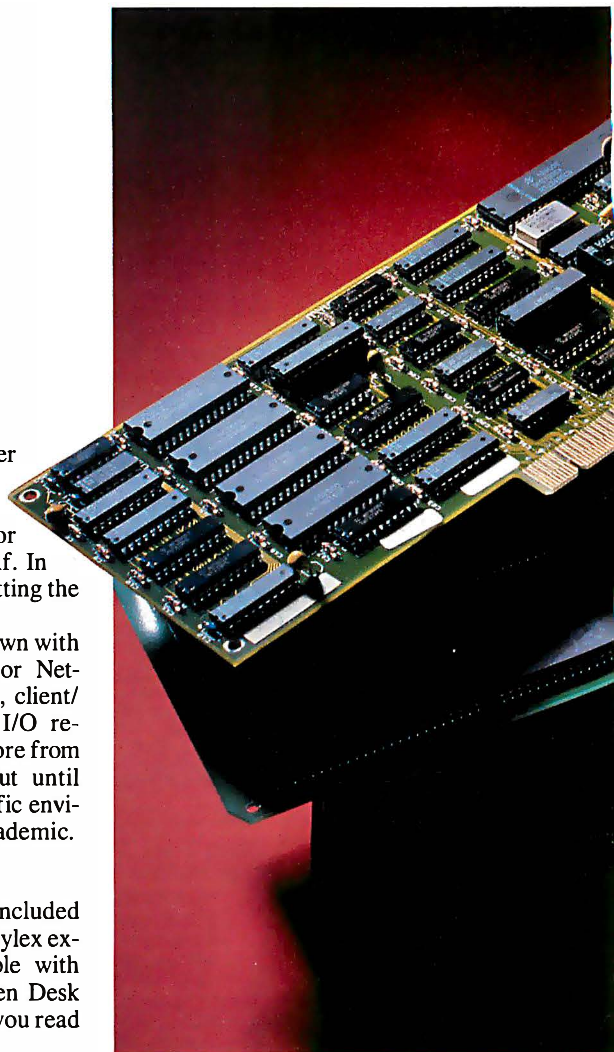
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HARDWARE

Ethernet's 32-bit Players

RICK GREHAN



Performance bottlenecks occur everywhere, but they are particularly insidious in LANs. More often than not, the server hard disk drive is the laggard. But when the network adapter is to blame, a 32-bit board might be the cure. To find out the kind of performance these boards offer, I tested three Ethernet EISA-bus adapters from Mylex, Novell/Anthem, and Racal-InterLan. See the table on page 242 for a list of each board's features.

An EISA-bus machine is a natural choice as a network server. Its 32-bit bus promises higher throughput, and given that the server is a network's focal point, you will want a high-performance file server. The three cards I tested support (or will support) more than just NetWare, but all three companies consider NetWare their primary market. So, if your LAN has begun dragging its feet due to increased client load, the offerings in this article could provide some relief.

One advantage of EISA is that installation doesn't require setting DIP switches according to a diagram in an installation guidebook. You simply run configuration software that makes the system aware of the new adapter and its features. In most cases, the installation process boils down to simply selecting the defaults. The EISA configuration software is intelligent enough to inform you of any conflicts. Consequently, the process of getting an EISA card installed and the server operational often takes less time than in an ISA system, although it still won't compensate for human error (see the text box "Lab Notes: Mind Your IRQs" on page 243).

Novell/Anthem's NE3200 comes with its own 80186 coprocessor; Mylex and Racal-InterLan don't use one. At first glance this appears to be a distinct advantage for the NE3200, since its coprocessor can off-load work from the host processor. But Mylex and Racal-InterLan claim that as the CPU power in EISA systems increases, the NE3200's 80186 coprocessor lags far behind the host processor and becomes a bottleneck in itself. In this scenario, you're better off letting the host system do all the work.

A 386-based server bogged down with value-added processes (VAPs) or NetWare loadable modules (NLMs), client/server applications, and disk I/O requests would probably benefit more from the Novell/Anthem adapter. But until you put the cards into your specific environment, these arguments are academic.

Mylex LNE390

The Mylex LNE390 I tested included only NetWare driver software. Mylex expects to have drivers compatible with SCO Unix 3.2.0 and ODT (Open Desk Top) 3.2.1 available by the time you read this.

Communication between the card and host takes place through the LNE390's dual-ported RAM. This means that memory on the card actually appears in the physical address space of the host (referred to as a *shared-memory* interface). The LNE390 uses zero-wait-state static RAM, so the host can read and write data as fast as the bus can carry it. Mylex claims a transfer rate of up to 16 megabytes per second.

Mylex says that dual-ported RAM works better than DMA because most network traffic consists of many small packets, and the cumulative setup-time overhead associated with DMA transfers greatly affects performance.

The LNE390's performance is dependent on the host processor rather than its own coprocessor. This architecture is advantageous for an EISA card, Mylex claims, since an EISA-bus server will almost certainly have a powerful CPU.

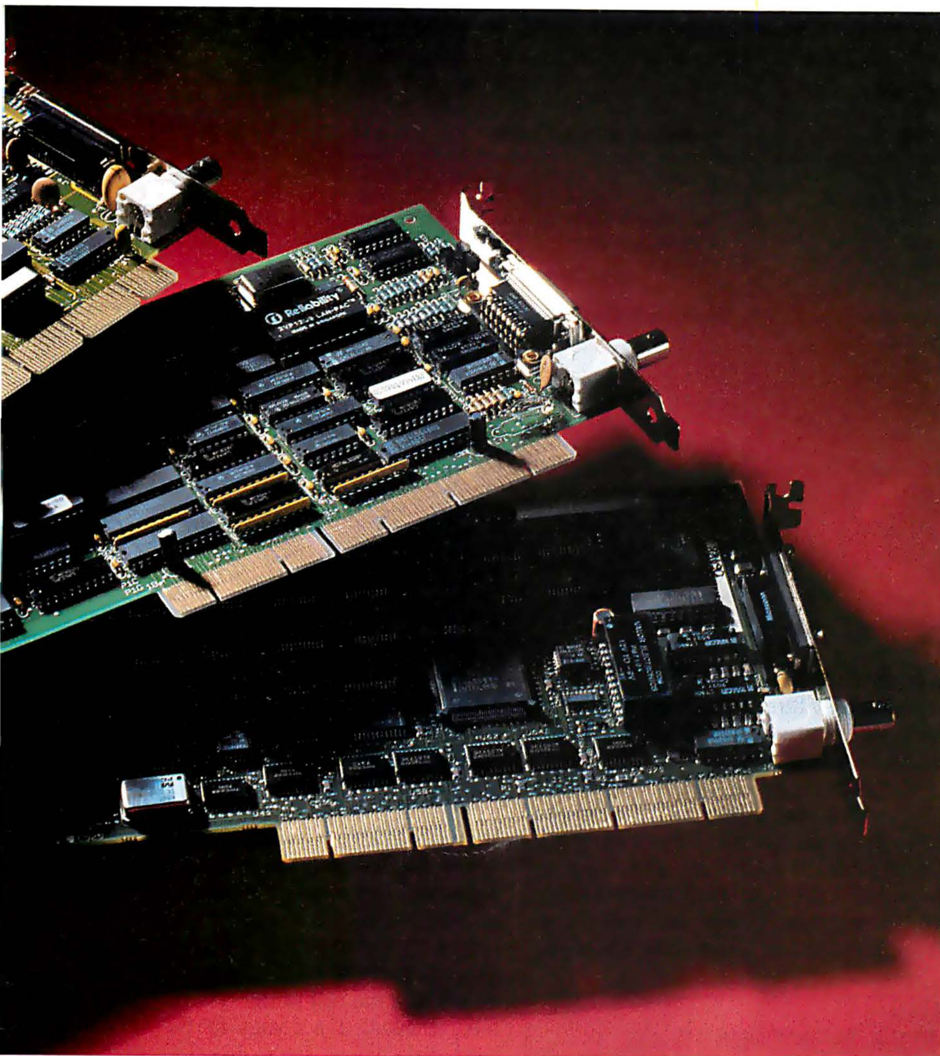
The adapter carries thin and thick Ethernet interfaces; you select the appropriate physical medium by way of a jumper block. The default configuration is thin Ethernet.

Documentation consists of a 36-page booklet documenting setup and installation for Mylex's 16-bit ISA adapter card as well as the 32-bit EISA adapter. It includes brief guidelines for setting up networks and contains such details as maximum cable lengths and how to install repeaters on multisegment networks.

Mylex includes NetWare 286 and 386 drivers and diagnostic software. You can configure the board as a client or server. The diagnostic software performs a "loopback" test: It simply sends a packet out and checks the echo. It also checks configuration details (base address and interrupt request line settings), as well as the health of the dual-ported RAM.

Novell/Anthem NE3200

The NE3200's unique feature is its onboard general-purpose coprocessor—a



The Mylex LNE390 (left) offers the most flexibility. You can configure it for DMA, I/O-mapped, or memory-mapped operation. The Racal-InterLan ES3210 (center) communicates via shared memory. Novell/Anthem's bus-mastering NE3200 (right) is the only adapter with an on-board coprocessor.

BYTE ACTION SUMMARY

- **EISA ETHERNET ADAPTERS**

- **WHAT THEY DO**
  These boards take advantage of a host computer's 32-bit EISA bus to improve throughput between the host CPU and the network interface card.

- **DO YOU NEED ONE?**
  EISA Ethernet adapters are ideal for file servers that suffer from heavy network traffic, but other components may be the culprit. A 32-bit network adapter does nothing to solve performance problems arising from a slow server hard disk drive or CPU, or from excessive collisions on a congested network.

- **WHAT YOU SHOULD KNOW**
  Currently, most boards only work with file servers. That won't help if you're trying to improve EISA workstation throughput.

- **WHAT WE RECOMMEND**
  The Mylex LNE390 is our choice. It offers comparable performance to the Racal-InterLan and Novell/Anthem boards, but at $395, it costs less than half as much.

10-MHz 80186. I say *general-purpose* here to distinguish it from the more task-specific network interface controllers, such as the National Semiconductor DP8390, found on the Mylex board. The added on-board intelligence of the 80186 and a bus-master interface chip enable the NE3200 to use bus mastering to communicate with the host. With bus mastering, the coprocessor temporarily takes over the bus to perform data transfers directly to and from host memory. Novell claims that this boosts overall throughput at the server by relieving the host CPU of the mundane chores of transferring network data packets. The CPU can focus on server processing instead.

As you might guess, the NE3200 is compatible only with NetWare. Specifically, you can configure it only for a NetWare 386 server. Novell recommends its ISA-bus NE1000 and NE2000 network interface cards for use in client systems.

The NE3200's manual includes plenty of up-front information for planning your network, and it covers Novell's other adapter cards as well. The manual's pages come prepunched for insertion into a NetWare manual binder. The documentation also has a beefy section describing how you install server driver software. Users familiar with Novell's NetWare documentation will feel right at home with this stuff. For driver software updates, Novell maintains a conference on CompuServe. CompuServe users can dial in and download the latest version of the board's driver software.

Racal-InterLan ES3210

The Racal-InterLan board can communicate with the host CPU using any of three methods: type-C burst DMA, I/O mapping, or memory mapping. All three methods allow for 32-bit data transfers, and all three are fully redundant: You can use any method to completely control the card. Racal-InterLan built in this redundancy for flexibility. If the memory-mapped mode conflicts with other peripheral cards in your system, you can use I/O-mapped or DMA mode.

I tested the card exclusively in type-C burst DMA mode, which Racal-InterLan says provides the fastest performance. But this doesn't mean that the card will always operate in DMA mode. In some cases, the driver software can examine the size of an incoming packet and—if it's small enough—select I/O mode instead of DMA. Mylex does this because, in this situation, the I/O-mode transfer time is less than the time software would

EISA ETHERNET ADAPTERS

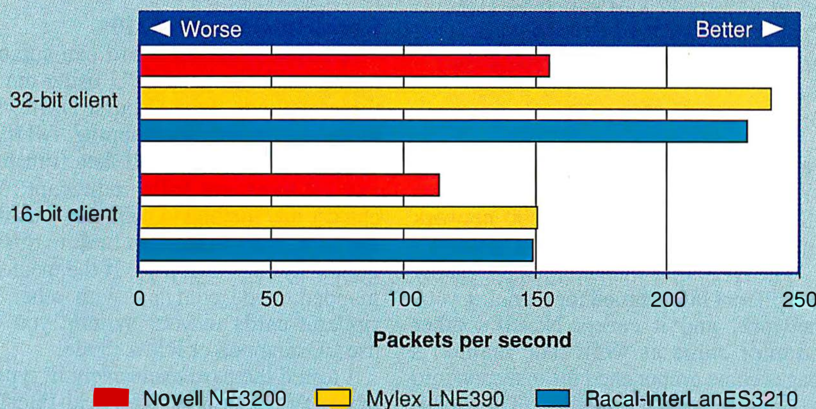
Of the three boards tested, only the LNE390 included driver software for workstations and servers. Only Racal-InterLan's ES3210 supported non-NetWare LANs.

	Mylex LNE390	Novell/Anthem NE3200	Racal-InterLan ES3210
Company	Mylex Corp. 47650 Westinghouse Dr. Fremont, CA 94539 (415) 683-4600 fax: (415) 683-4662	Novell/Anthem Electronics, Inc. 1040 East Brokaw Rd. San Jose, CA 95131 (408) 453-1200	Racal-InterLan, Inc. 155 Swanson Rd. Boxborough, MA 01719 (800) 526-8255 (508) 263-9929 fax: (508) 263-8655
Network drivers	NetWare 286 2.1x; NetWare 386 3.x	NetWare 386 server	NetWare 286 2.15 server; NetWare 386 server; Microsoft NDIS (MS-DOS and OS/2 versions); Unix Streams; Banyan Vines 4.x server
On-board coprocessor	None	80186	None
Host communication method	Shared memory	Bus mastering	Type-C burst-mode DMA; I/O mapped; memory mapped
Price	$395	$1295	$995
	Circle 1227 on Inquiry Card.	**Circle 1228 on Inquiry Card.**	**Circle 1229 on Inquiry Card.**

take to configure the DMA hardware.

The ES3210 runs only as a server on a NetWare network. However, workstation drivers should be available by the time you read this. Racal-InterLan also includes Network Driver Interface Specification (NDIS)-compatible drivers for use with LAN Manager, as well as driver software for Banyan's Vines 4.x symmetric multiprocessing server software (which runs exclusively with the Compaq Systempro). The ES3210 also includes AT&T Streams-compatible driver software for use with SCO Unix or Interactive Systems Unix.

Racal-InterLan devotes the ES3210's 40-page manual primarily to hardware installation and testing; there's not much about driver installation. The manuals provided with your network-operating-system software should tell you everything you need to know about installing the cards, but Racal-InterLan could have provided more guidance here. Feeling lost? The company has a technical-support line and a BBS you can call for helpful tips and copies of the latest drivers.



The benchmark tests measure turnaround time for processing requests for workstation node connection numbers and internetwork addresses in a NetWare LAN. I ran the tests on an i486-based server from clients with 16-bit and 32-bit Ethernet adapters. The Mylex board took the top spot, with the Racal-InterLan board a close second. Both boards rely on the host CPU, which outpaced the 80186 coprocessor in Novell/Anthem's NE3200. On a heavily loaded server, the NE3200 would likely fare better.

Benchmark Comparisons

When the server network adapter is the bottleneck on a LAN, a 32-bit network adapter helps by decreasing the time required to service a request. I wanted to exercise just the LAN adapter card and driver, not the rest of the system. Therefore, I avoided accesses to the server hard disk drive, since disk I/O would have added another variable to the tests and would have added considerably to response time.

To that end, I devised a test that made repeated calls to two of Novell's extended DOS services—specifically, two connection services. The first service I used, *get object connection numbers*, returns a list of up to 100 connection numbers identified with a particular log-in name. For example, if another user on the network were logged in as ALPHA, I could pass this service routine a request to locate ALPHA's connection numbers. (You'll have more than one connection number if someone has logged in as ALPHA from more than one client station.)

Next, I performed a call to the *get internet address* service. Once you've gotten the connection number, you can issue this call to obtain a client's internetwork address. The internetwork address consists of a network number, a node address, and a socket number: all the information you need to send IPX packets

Lab Notes: Mind Your IRQs

During testing, I had some trouble bringing up the Mylex LNE390. The problem turned out not to be the card's fault, and this points out how tricky adapter installations can be—even on an intelligent EISA bus.

I installed the card and then ran the EISA configuration program so that the system's power-on self-test routines would properly recognize the card. One of the adapter's configuration parameters is its interrupt request (IRQ) number. I set it to a value that didn't conflict with those of any other cards in the system. (The configuration software is smart enough to detect conflicts.) Later, when it came time for me to use the NetWare SHGEN utility to build a working copy of Novell's IPX, I inadvertently configured IPX to recognize a different IRQ number.

The card wouldn't work, of course. What made detecting the mistake tough was the fact that the loopback tests showed that the card was functioning properly. It wasn't until I connected a Network General Sniffer to the system that I began to suspect the problem. The protocol analyzer showed the card sending packets to the server and the server transmitting replies, but the card appeared to ignore the replies.

That's when I guessed my error: The loopback test software is *not* interrupt-driven, nor is the sending portion of the IPX driver. However, the receiver portion of the IPX software *was* interrupt-driven, and since I had mixed up what the card was expecting and what IPX was expecting, everything came to a halt while IPX waited for an interrupt that would never occur. The moral of the story: Remember your IRQ settings when you configure EISA LAN adapters. Better yet, write the settings down.

directly to that client.

Each call to either of the above routines triggers the exchange of packets between server and client. Hence, each loop through the benchmark test sends four packets across the network. Packet length ranges from approximately 64 to 100 bytes. The server maintains all connection information in memory, so disk I/O never takes place.

I used a Compaq Deskpro 486 with 8 MB of memory as the server station. This attended two client stations: one a Compaq 386 EISA system with 12 MB of RAM, and the other a Gateway 2000 386SX AT-bus system with 4 MB of RAM. I kept a Mylex LNE390 card exclusively in the Compaq workstation for all tests (this card was the only adapter in the group that could run as client). The Gateway system housed an 8-bit Western Digital WD8003EB Ethernet adapter.

I tested each of the three EISA Ethernet cards in the server. The driver software and the network adapter changed from test to test; all other hardware and software in the server and the client machines remained the same. I used Network General's Sniffer to monitor the network and watch for dropped packets while running the tests.

The benchmark results in the figure represent the average of 10 runs for each board; I used the Compaq with the Mylex LNE390 board as the 32-bit client and the Gateway machine with the Western Digital adapter as the 8-bit client. The results reveal how quickly each card can process simple requests in the test configuration. But don't take these numbers as conclusive; in the real world, a file server handles a mixture of server activities, which adds complexity to the performance equation.

A request for an internetwork address is an activity likely to occur frequently on a network; vast streams of repeated requests are not so common. It's likely, for example, that this benchmark never gave the NE3200's coprocessor a chance to "coprocess"; the NE3200 might have scored higher if the benchmark had placed a wider range of demands on the server. So while you can compare the Mylex and Racal-InterLan results directly, the Novell/Anthem board's numbers don't tell the whole story.

For a baseline, I also ran the benchmark tests with a Novell 16-bit NE2000 Ethernet adapter in the server. Both the Mylex and Racal-InterLan cards performed roughly 40 percent better than the NE2000. But the NE3200 appeared to be slower than the NE2000, because the i486 server CPU did a better job than the NE3200's 80186 at processing requests. Again, the NE3200 would fare better in environments where the server CPU has a heavy processing load.

Server Improvements

EISA LAN adapters come very close to being "plug and play." All come with adequate configuration and diagnostic software, and if you read the instructions carefully, there's little likelihood you'll get into trouble.

From a performance perspective, the Mylex board did marginally better than the Racal-InterLan board. The Novell/Anthem board scored low in the benchmarks, but keep in mind that the test ran the network "flat out" with no possibility of collisions—an unlikely condition that becomes more unlikely as networks grow and more clients contend for service. Finally, remember that companies frequently update the driver software for their LAN adapters. Given that this software can account for a large portion of a LAN adapter's performance, a poor showing this month might disappear next month with a new software release. Any of these cards should significantly improve server throughput problems caused by slower network adapters.

What differentiates these products is price. Here the $395 Mylex LNE390 is the obvious choice. It can operate in either client or server machines. The prices for the Novell/Anthem NE3200 adapter ($1295) and the Racal-InterLan ES3210 ($995) don't compare. If you need an EISA-bus Ethernet board, the LNE390 should top your list. ■

ACKNOWLEDGMENT

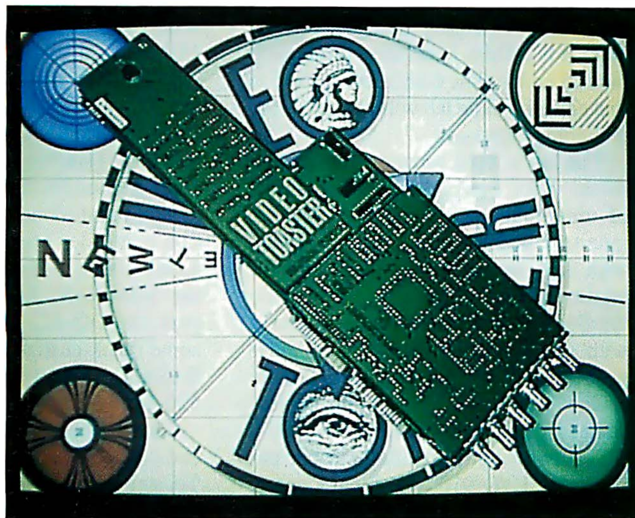
Thanks to Barry Nance, author of Network Programming in C, *for his help and input on the network interface adapter benchmarks. Source code from his book served as the foundation for the benchmark tests.*

Rick Grehan is technical director of the BYTE Lab. You can reach him on BIX as "rick_g."

HARDWARE

Newtek's Video Toaster Makes Professional Video Affordable

TOM YAGER



Create professional video presentations on your Amiga with the Video Toaster from Newtek.

So, the big presentation to the board of directors is next week, and you haven't even gotten started. You have the raw materials—overhead transparencies, live video, and charts and diagrams—but you don't know how to put it all together. You really have to knock their socks off; sleepy slide shows and squinty PC presentation graphics are out of the question.

You could go out and have a video presentation made, complete with animated logos and fancy special effects, but it would cost a fortune. Making changes and producing the other presentations you have lined up would cost a similar fortune each time. Maybe it makes more sense to put together your own facility; given what production houses charge, it could pay for itself in a year.

Newtek's Video Toaster is unarguably the most complete computer video production package for the money. For only $1595, the Toaster serves up a video switcher/special-effects generator, a 24-bit paint program, a full-featured character generator, a three-dimensional modeler/renderer/animator, and a color special-effects module.

The software works its magic through a sandwiched pair of circuit boards that install in the video slot of a Commodore Amiga 2000 or 2500. The hardware provides two pages of 24-bit frame storage, six BNC video connectors (four in and two out), and loads of custom Newtek ICs that make the Toaster's incredible real-time manipulation of video possible. For all its wonder, however, the Toaster is not for everyone, and its $1595 price tag is only the start of what you'll have to spend to make full use of the product.

Where Does the Joystick Go?

The Amiga community has been quivering with anticipation since word of the Toaster's development first leaked out years ago. Unfortunately, most current Amiga users don't have what they need to make the best use of the Toaster. This isn't a video toy; Newtek's goal was to create an affordable *professional* video production tool. That brings with it certain equipment requirements and assumes you're interested in a high level of quality. As a result, if your video setup amounts to a VHS VCR and a camcorder, you can't use them together with the Toaster.

I tested the Toaster in an environment presenting close-to-optimal conditions (see the text box "The BYTE Multimedia Lab" on page 246). The facility was operational, capable of creating commercial-quality video productions, before the Toaster arrived. That's an important point, because that's more or less how the Toaster is intended to be used. If you already have (or plan to invest in) the professional or semiprofessional equipment needed to create high-quality video, then you'll have the right foundation for the Toaster.

Knowing what else you need to run the Toaster is crucial. Even though it carries a $1595 price tag, the equipment you need to put it to best use is still quite expensive. A significant part of the cost of implementing the Toaster relates to its requirement that all the incoming video signals be synchronized to one another. This is called *frame synchronization*,

BYTE ACTION SUMMARY

- **NEWTEK VIDEO TOASTER**
- **WHAT YOU'LL LIKE**
  The Video Toaster is the most complete desktop video production product available, an incredible value at $1595.
- **WHAT YOU'LL DISLIKE**
  It's not the Toaster's fault, but it'll cost you to really put it to full use. Around $25,000 for a starter setup (including the Amiga) is reasonable.
- **WHO SHOULD BUY**
  Businesses, schools, and other institutions or individuals wishing to produce high-quality videos and presentations.
- **SYSTEM REQUIREMENTS**
  Amiga 2000 or 2500 with 7 MB of memory, an Amiga 1080-series or compatible monitor, and an empty video slot
- **WHAT YOU'LL PAY**
  $1595
- **FOR MORE INFORMATION**
  Newtek, Inc.
  115 West Crane St.
  Topeka, KS 66603
  (913) 354-1146
  fax: (913) 354-1584
  Circle 1076 on Inquiry Card.

The BYTE Multimedia Lab

Newtek isn't the only company interested in desktop video. Businesses everywhere have been waiting for the chance to produce their own videos and bypass the high fees and long waits of working with production houses.

A few months ago, I started working with companies in the computer hardware, software, and professional video industries, with an eye toward constructing a working model of a corporate in-house video production facility. That facility, dubbed the BYTE Multimedia Lab, is now operational (as evidenced by the Video Toaster review, produced entirely in the lab). Getting there involved securing the cooperation of several companies, selected for their commitment to computer-assisted video production and to upholding the high-quality standards that BYTE readers and corporate video producers expect.

The Multimedia Lab is more than a test-bed for emerging multimedia products. It is a fully functional production facility and will be continuously used in that capacity. The lab will change as the technology changes.

The lab is built around Sony professional video equipment, a combination of videotape recorders, camcorders, monitors, and editing equipment. I went with Sony because of its reputation for quality (proven in practice) and because the Sony product line blends perfectly with the needs of the small in-house production facility. The Video Toaster review required PVM-1342Q professional video monitors, EVO-9800 Hi-8 VTRs (with built-in time-base correction), an EVO-9100 Hi-8 camcorder, and a BVU-950 U-matic SP editing/animation VTR. You can reach Sony's professional video division at (800) 523-7669 (in Canada, (416) 499-1414).

The lab's Amiga is a Model 2500/30 with 7 megabytes of memory and a 40-MB internal hard disk drive. (You can reach Commodore's Amiga division at (215) 431-9100.) I added a 330-MB Micropolis ((818) 718-5555) hard disk drive to give the Toaster's software some needed breathing room.

The stand-alone single-frame animation controller was served up by Lyon-Lamb ((818) 843-4831) in the form of the Mini-VAS. Its PC-based counterpart, the DQ-422 (which permitted me some quick customization in Microsoft BASIC), came from Diaquest ((415) 526-7167).

These, plus some Radio Shack cables and connectors, are all it took to set the Toaster to toasting. Coming feature articles will explain in greater detail what computer-assisted video production is all about and help guide you through the maze of products that make it all work.

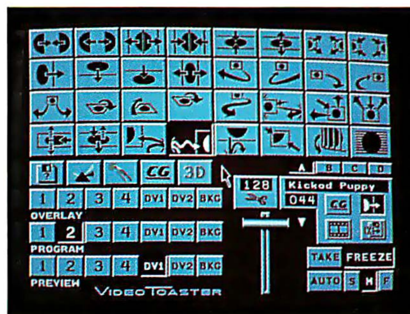
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and it certainly isn't cheap. An external time-base corrector/frame synchronizer, such as the Sony MPU-F100, goes for around $4000, and that's just to synchronize one video signal (although it performs other duties, too). Time-base correction is less expensive when it's built into a videotape recorder (VTR), as with Sony's Hi-8 and some other late-model professional decks.

There are other extra-cost factors that I'll cover as I go along, but the most important is memory: The Toaster documentation laments those users who have "only 5 megabytes of memory" and recommends 7 MB or more. It's not kidding; don't even bother trying to run the Toaster software in a 3-MB machine.

There's a Switch

As I mentioned, you insert the Toaster into the video slot of an Amiga 2000 or 2500. There is only one such slot, so your Amiga's genlock or scan-doubler might have to go. Also, because the Toaster genlocks the Amiga's display to the signal on video input 1, you have to use a monitor (e.g., the Amiga 1080 series) that requires composite (as opposed to separate horizontal and vertical) synchronization. The Amiga 1950 monitor won't work with the Toaster.



Screen 1: *The video switcher.*

The software mostly installs itself; you launch it from Intuition (Amiga's graphical user interface) by double-clicking its icon. This brings up the video switcher module, which, like all other Toaster modules, takes over the entire Amiga screen. The switcher's interface (see screen 1) is built much like that of a stand-alone video switcher/digital video effects (DVE) module. It is sensible and easy to learn, and it makes the switcher perhaps the best thing about the Toaster.

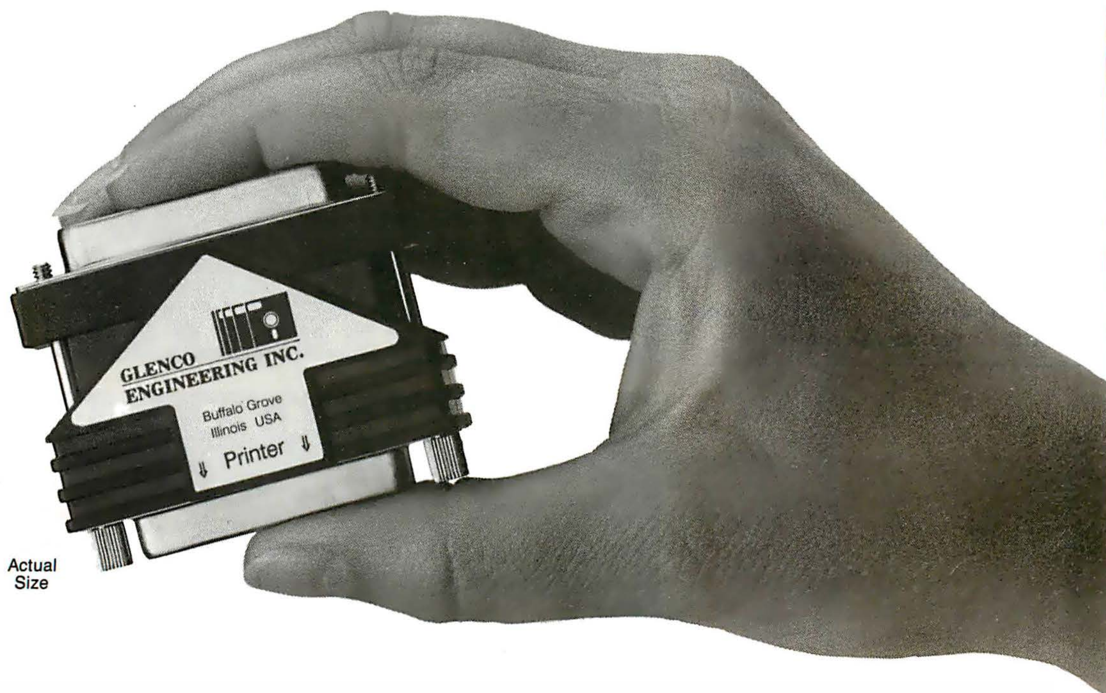
In addition to the external video sources plugged into the Toaster's inputs, the switcher adds three more: two pages of 24-bit image storage (marked DV1 and DV2) and one background generator. The switcher lets you make transitions from any of these sources to any of the others, but it doesn't just replace one image with another. There are dozens of eye-popping digital effects in the Toaster that help you keep your presentation interesting. Even if you're just presenting the video equivalent of a slide show, well-chosen (not overdone) transitional effects can help you keep your audience interested. These effects operate on both still and moving video, so even while your frame tumbles end-over-end into oblivion, the video contained in it is displayed, moving, in real time.

The array of effects is staggering, and Newtek's design enables the company to add new ones through software upgrades. One floppy disk could hold dozens of new effects. The effects run the gamut from fades and wipes to complex 3-D tumbles and page turns; a handful of representative effects are laid out in photo table 1.

Those who are in the professional broadcast and video production fields have certain expectations when it comes to switcher/DVE units, and the Toaster meets only some of them. It lacks one

INTRODUCING

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Our unique ASIC (Application Specific Integrated Circuit) extends the Hardlock's operating range below 2 volts. Since no idle current is required, there is no additional loading on the printer. Electronically erasable memory **requires no battery.**

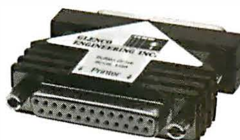
Flexible

Field programmability is now possible. Additionally our optional Crypto Programmer board permits the Hardlock to be uniquely programmed for your company.

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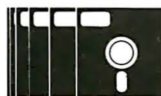
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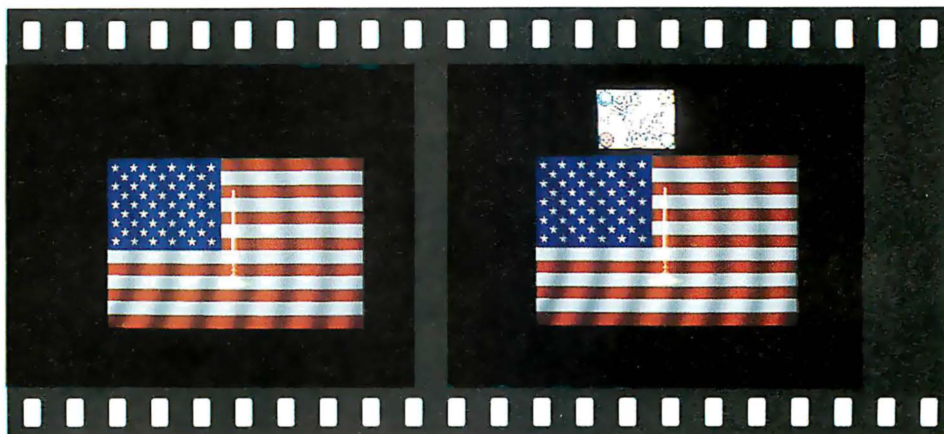
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Circle 125 on Inquiry Card.

SOME TRANSITIONAL EFFECTS

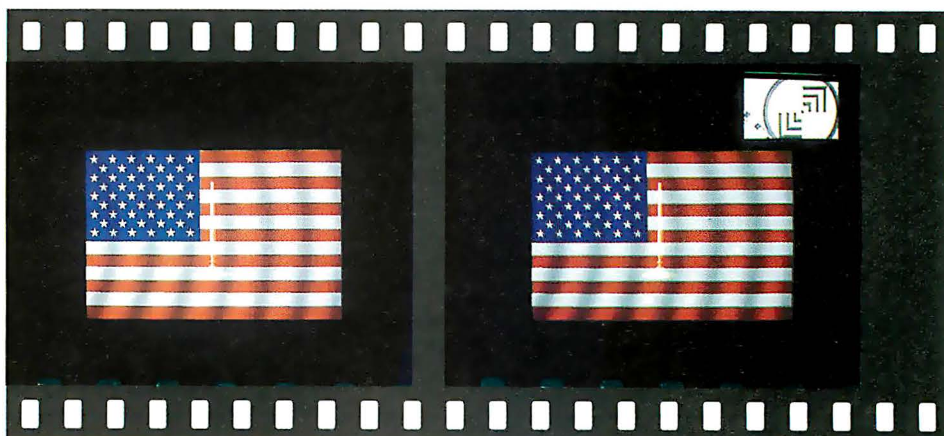
Photo table 1: *The Video Toaster's switcher makes a transition from one video source to another through user-selected special effects. If not overused, effects can add punch to an otherwise lackluster presentation. There are dozens of effects, many of them more complex and impressive than these.*



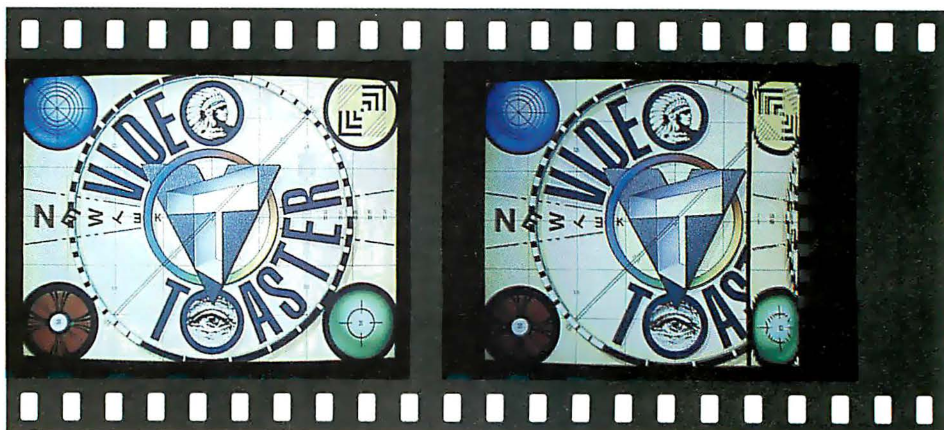
Trajectory with compression. *The image starts out small, "flying" in from a corner, and following a smooth path and growing to occupy the full screen.*



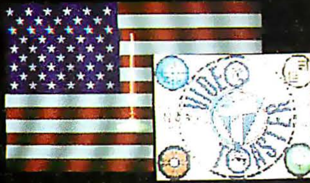
Smooth fade. *Probably the cleanest, most useful effect of the lot. Can be stopped in the middle for composite effects.*

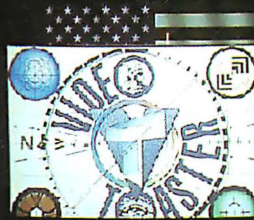


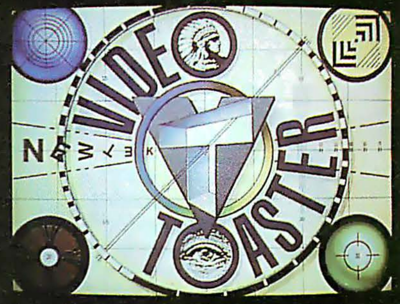
Corner wipe. *Reveals a full-size underlying image by starting at one corner and wiping a rectangular area diagonally across the screen.*



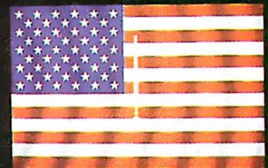
Page roll. *"Curls" like a sheet of paper, rolling the image into a tube and off the screen.*

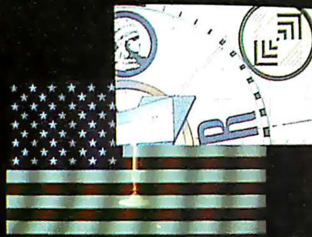


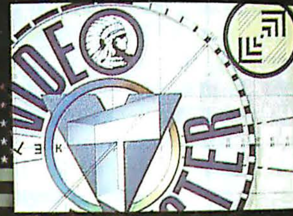


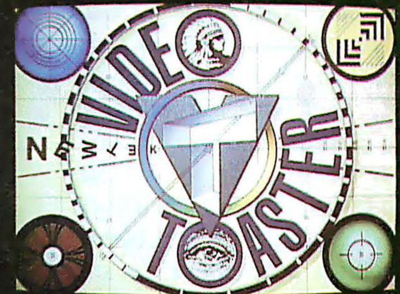

VIDEO
TOASTER

Welcome to Cashco's
Managers' Roundtable
WORKING GROUP MEMBERS
Working group sessions
begin at 1:00. See your
group leader for materials.



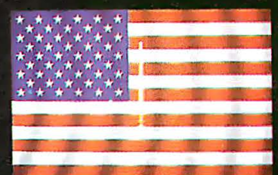


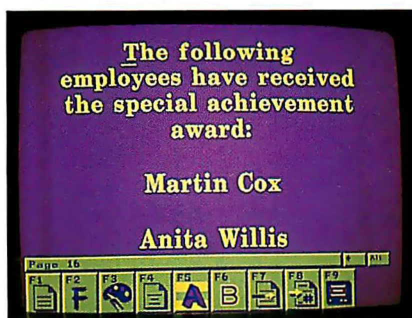



VIDEO
TOASTER









Screen 2: *The character generator.*

crucial capability: real-time scaling (compression) of video input. Costly stand-alone DVE units can cleanly scale video to any size on the fly. The Toaster does support 3-D effects (like tumble, in which the image flips end over end and gets smaller), but, instead of scaling, it fragments and discards portions of the image to make it smaller. As a result, an image that's scaled down by as little as 30 percent looks shabby.

Audio follow is usually an add-on to stand-alone switcher/effects units; it mixes the audio signals for you as the video makes a transition. There isn't any way to do this with the Toaster, but the switcher's controls are built to be operated with one hand (leaving the other free to operate an audio mixer). The switcher is not an edit controller, so you have to control your VTRs by hand. This can be interesting if you're mixing two source tapes down to one destination tape; you will have three decks to control. Luckily, the Toaster does have a General Purpose Interface, so the transitions can be triggered by an external device (e.g., an edit controller that will run your VTRs for you).

To the Toaster's credit, most of its effects are nice and clean, and there's more than enough dazzle to go around. The effects that require scaling speed up as the image gets smaller, so the viewer's eye is tricked by the constant motion.

In addition to transitions, the switcher lets you overlay images through *linear keying*. This method allows everything darker (or lighter) than a certain shade (expressed numerically) to go transparent, revealing an underlying image. For example, you could paint a logo onto a black background and then use the linear keyer to layer that on top of a video source. Similarly, you could also point a video camera at a model in front of a black background and use the keyer to put her on the beach, in space, or anywhere your painting, grabbed frame, or moving video can take her.

Linear keying isn't perfect, however. In the case of the model, if her outfit had any black in it, that too would show through to the beach scene, along with the pupils of her eyes, her black hair, and some shadows. Linear keying works best with graphics and other still artwork that can be modified until they layer cleanly.

Last, the switcher includes a versatile frame store, or gallery of still images. The frame store can hold images from the paint program, 3-D renderer, or any video source (you can instantly grab and save frames from within the switcher). Each image is stored in a separate file on disk, and you can assign a unique three-digit number to make selecting among them easier. An image takes only about 4 seconds to load from disk, making quick insertions of still images into live video possible.

Giving Your Video More Character

Closely allied with the switcher is the character generator. Clicking the switcher's CG button once loads the module; clicking again brings up the page builder (see screen 2).

The page builder is entirely keyboard-driven (there is no mouse support), in the design tradition of stand-alone character generators. Text is laid out on the Amiga display, with font, color, shadowing, and other characteristics variable for each line. You can present pages of characters in four ways: key pages, frame-store pages, and scroll and crawl pages (see photo table 2 for examples). Key pages use the linear keyer to create overlaid titles (e.g., a newscaster's name), while frame-store pages have their own background (solid or gradated colors) and are called up as complete images. Scroll and crawl pages are keyed text that moves vertically and horizontally across the screen, respectively.

Pages that are created in the character generator are called up directly from the switcher (a nice touch). Like the frame store, each page in the character generator is tagged with a three-digit identifier; the first few words of the page are displayed in a small window as well.

The character generator produces reasonably high-quality images, but it has its limitations. It uses bit-map fonts, as opposed to outline fonts (you can use only those sizes provided—text can't be scaled). You have to convert logos and other graphics to fonts before you can use them, and the Toaster software doesn't provide a facility for this. Text attributes (e.g., color and shadowing) can't be applied differently to a character or a word, only to an entire line.

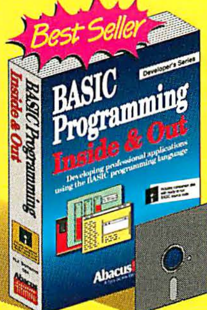
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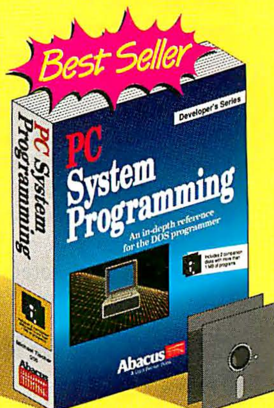
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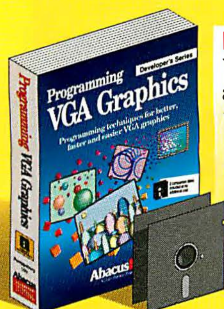
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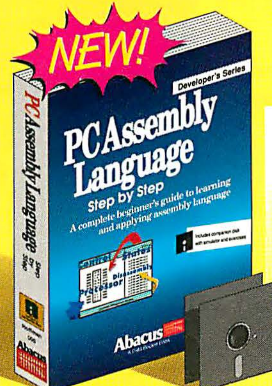
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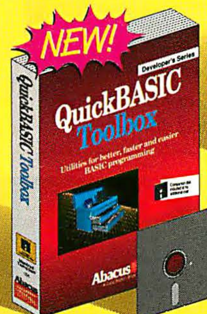


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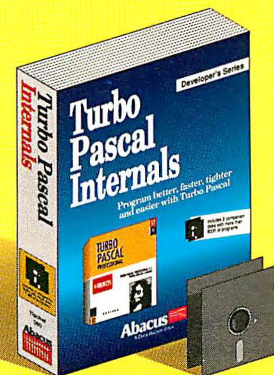
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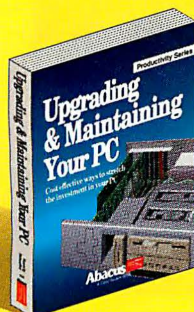
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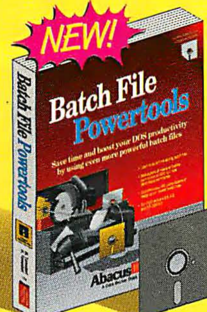
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Still, the character generator's quality is impressive. Creatively combining the character generator, frame store, and switcher can result in presentations that put traditional slide shows and PC-generated graphics to shame.

Opening the Paintbox

Often, there is a need to retouch captured images or to create artwork from scratch. The Toaster provides an impressive 24-bit paint program to perform these tasks. The interface is a combination of icons and menus (see screen 3); pressing the right mouse button replaces the icons with a pull-down menu bar. This is as complete a paint program as anyone could want, and those who are familiar with Newtek's previous efforts in this domain know what to expect.

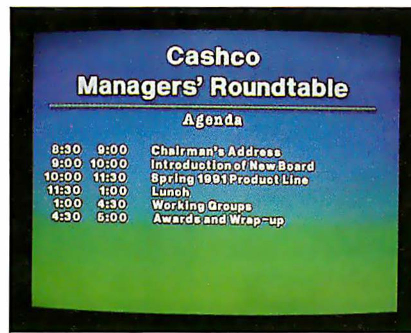
Painting is done entirely on the Amiga screen in the interest of speed, and colors are approximated down from 24 to 12 bits (4096 colors). Accurate color information is stored, however, and by clicking on an icon, you can have a frame rendered to the program monitor with full resolution and range of colors.

There are several tools that make retouching captured video much easier. You can make any portion of the screen into a brush, which can be "stamped" onto the canvas with varying degrees of transparency and with smoothed edges. You can colorize images and draw spline polygons that can be filled with color to retouch irregularly shaped objects.

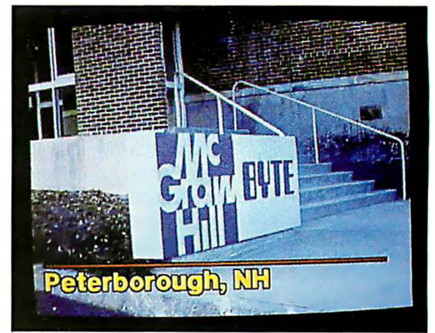
You can also map a brush to any 2-D shape, applying variable scaling to the image to fit it inside the shape. Mapping a brush to a circle, for example, would result in an image that was normal in the center but smaller and more distorted near the edges. Three-dimensional

CHARACTER GENERATOR PAGE TYPES

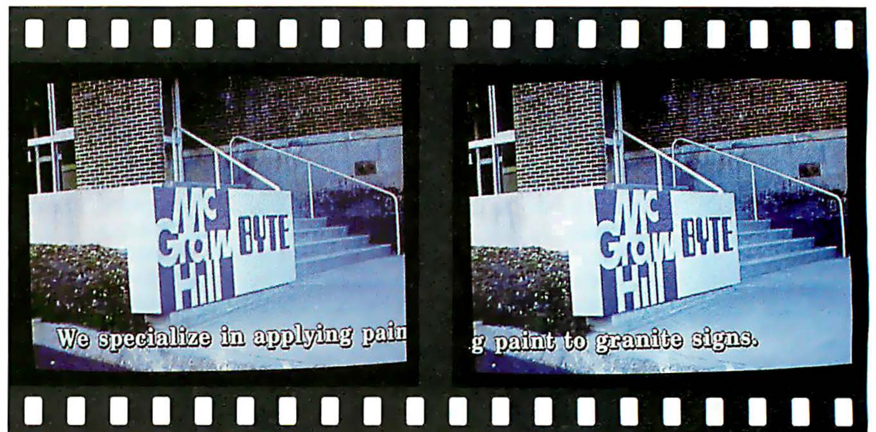
Photo table 2: *The character generator can create professional-looking text in a format suited to your presentation.*



The frame-buffer page, complete with gradated background and shadows.



The key page, shown here layered over live video.



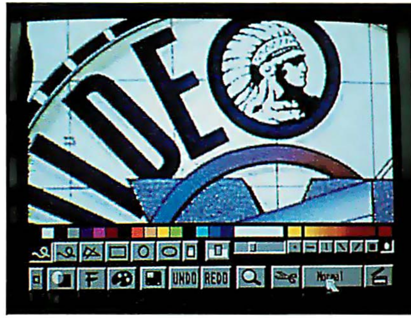
The crawl page. *Text "crawls" across a selected position on the screen, at a selected speed, from right to left. Text is automatically layered over a chosen video source.*



The scroll page. *Text scrolls from bottom to top at a selected speed, layered as with the crawl page.*

objects can also be simulated through gradated shading.

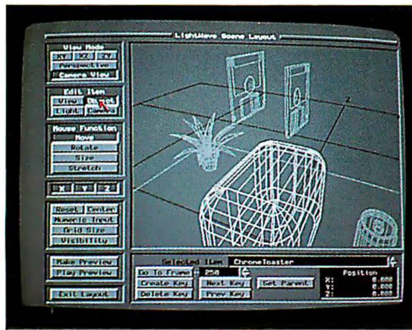
The paint program is nicely done and deserves high marks for usability. It is loaded with features, more than most people need, and even the more obscure elements of the package show a commendable attention to detail. Charts, graphs, and all manner of presentation graphics can readily be produced here. My only complaint is that the character generator fonts are not available to the paint program—it has only the wimpy assortment included with the Amiga (although there are third-party font packs).

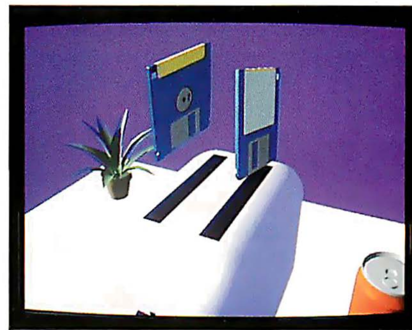


Screen 3: *The 24-bit paint program's iconic interface.*

The Toaster in 3-D

Perhaps the most exciting and time-consuming portion of the Toaster's software is Lightwave 3D, a combination 3-D modeler and renderer. The renderer is a masterpiece, combining a clear visual interface with loads of power. I could devote an entire review to this module alone, but I'll summarize instead: This is hot stuff. With some imagination and a bit of patience, you can create very realistic-looking 3-D scenes.





Screen 4: (a) *The scene as shown in the renderer's layout editor.* **(b)** *The finished scene.*

The interface is well laid out (see screen 4), making 3-D manipulations about as easy as they can be. The wireframe representation is displayed on the Amiga's monitor, and the speed (on the 68030-based Amiga 2500, at least) is impressive. Objects are drawn as boxes while they (or the scene) are being moved; all lines are drawn only after you stop moving things for a couple of seconds. This allows manipulations to take place in real time, with no delays waiting for objects to redraw. The interface is consistent, with the same scheme being used to move objects, lights, and the camera. Newtek has done a bang-up job of mapping 3-D movements to a 2-D device (the mouse).

Rendering is done on request, with full 24-bit color and selectable levels of resolution and image quality. Setting these to "low" allows you to see a quick preview of a scene. Even with smooth shading enabled, Lightwave is able to render a complete scene in as little as 30 seconds.

Lightwave ships with enough well-made objects to keep you busy for days, and the software is so versatile that I can think of only a couple of things you can't do with it. Objects that have reflective surfaces (e.g., glass and chrome) won't carry reflections of other objects in the scene. They will, however, reflect the sky and the floor (or any image of your choice), so the now-familiar glass or chrome sphere floating above a checkerboard will still work. Lightwave will render shadows, too, and this adds tremendously to the realism.

Aside from this, Lightwave does nearly everything a rendering package should do, and does it well. In addition to simple rendering, Lightwave can be configured to control an editing VTR for animation. By connecting a single-frame controller (from the likes of Lyon-Lamb or Diaquest), a professional-quality VTR can turn each rendered image into one frame of an animation. This takes time: At 30 frames per second, a 10-second animation takes 300 frames. Even at the best-case 30 seconds per frame (low-resolution), you're still about 2½ hours from a finished animation. If you take the time up front, though, Lightwave produces gorgeous results.

As for the modeler (the module that builds the objects), avoid it. Newtek reported at press time that it was overhauling the modeler (early purchasers of the Toaster are getting free upgrades), but the version I tested was in a sorry state. I can't remember when I've used such a cumbersome program. As good as the renderer is for its ease of use and versatility, the modeler is that bad for its awkwardness and limitations. I'll look forward to the upgrade, and to the promised utility that converts 3-D models from other (better) Amiga modeling programs to Lightwave format.

Color Me Finished

The Toaster's color special-effects module, ChromaFX, is nearly impossible to describe. ChromaFX alters the color palette according to a graph and then applies that modified palette to a video source. The results represent everything from posterization effects to people striped like zebras. There is no practical use for this module, but it is fun.

What you don't see when you buy a Toaster is the heap of innovative ideas that Newtek has planned as follow-ons to this flagship product. The company is committed to raising the quality and lowering the cost of video production. I will be following these developments as they appear. The Toaster is only the beginning—but what a beginning.

No matter how it's viewed, the Video Toaster is a marvel. There is no better value in any product category than the Toaster's $1595, considering everything it includes. Until now, it took mountains of cash and an array of individual, single-purpose devices to perform the Toaster's functions. Now, you can get started in commercial-quality video production for as little as $25,000 (including the Toaster, an Amiga, and some professional video gear). That's dirt cheap compared to even a year ago. If it still seems like a lot, however, there are ways to use the Toaster for less money; even if you just viewed it as a 24-bit frame-buffer board and never plugged in any live video sources, you'd still have made a good choice. ■

Tom Yager is a technical editor for the BYTE Lab and director of the BYTE Multimedia Lab. You can reach him on BIX as "tyager."

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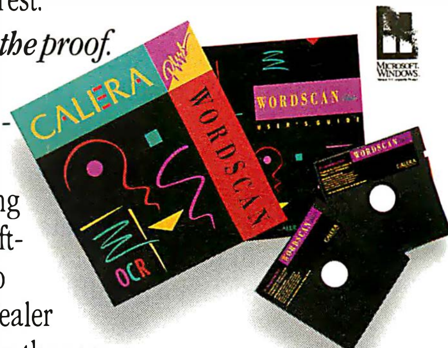
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SYSTEM

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The Mac IIsi, running Adobe Illustrator 3.0. The system is using its built-in video to drive the 8-bit (256-color) display.

Apple's modular Mac II-class computers are well known for their capabilities. They accept NuBus expansion boards, readily handle 24-bit color images, and include built-in FPUs that let them crunch numbers with gusto.

Unfortunately, these Macs are equally well known for their high prices.

The newest member of the modular family, the Mac IIsi, delivers most of the Mac IIci's processing punch—and some of its expandability—for about $1900 less. The Mac IIsi and its siblings, the Mac LC and Mac Classic, are the start of a new trend at Apple: reasonable prices. (For more on these machines, see "The New Macs on the Block" in the November 1990 BYTE.) The basic system, with 2 megabytes of RAM, a 40-MB hard disk drive, a keyboard, and a 12-inch color monitor, comes to $4497. I tested a IIsi with 5 MB of RAM, an 80-MB hard disk drive, a NuBus/68882 FPU adapter, a 13-inch AppleColor monitor, and System 6.0.7. This brought the price to $5946.

A Look Inside

The IIsi is a stripped-down Mac IIci. It's about as wide and deep as the IIci, but at 4 inches tall, it sits nearly 2 inches lower. The main logic board has the same application-specific ICs for memory addressing and on-board video and the same oscillators for the video and bus clocks. The 512K-byte ROM chips include 32-Bit QuickDraw, and the built-in video supports screen depths of from 1 to 8 bits and several types of Apple monitors.

But there are differences. The 68030 CPU clocks at 20 MHz (the IIci runs at 25 MHz). The IIsi doesn't have a 68882 FPU or a second Apple Desktop Bus port, and a single 120-pin expansion connector replaces the IIci's three NuBus slots. Special adapters that plug into this connector support either a NuBus slot or an 030 Direct Slot. These adapters come with a 20-MHz 68882 FPU and cost $249 each.

There's no programmer's switch: You can trigger reset and interrupt states by

BYTE ACTION SUMMARY

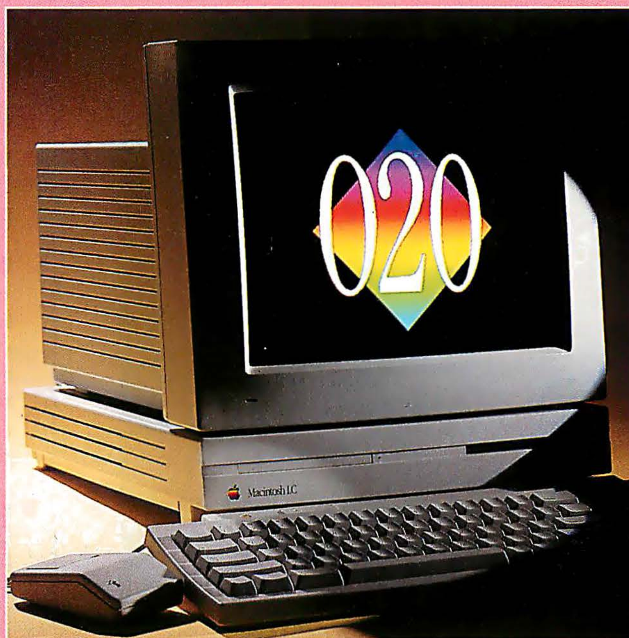
- **MAC IISI**
- **WHAT YOU'LL LIKE**
  The Mac IIsi rivals Mac IIci performance for $1900 less.
- **WHAT YOU'LL DISLIKE**
  The single NuBus/030 Direct Slot limits expandability, and the system's small power supply may not be able to handle both a second hard disk drive and an expansion board in some cases.
- **WHAT WE RECOMMEND**
  Go with the Mac IIsi if you need IIci power and can live with one expansion slot. The IIsi is also a good entry-level platform for running A/UX. But if you just want 8-bit color on the cheap, the 68020-based Mac LC may be all you need.
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The Mac LC: Low Cost, High Quality

Compared to the Mac IIsi, the Mac LC is positively diminutive. The machine is just as wide, but it stands a mere 3 inches tall and weighs a trim 8 pounds to the IIsi's 10. Inside, the LC is a Mac II reborn, with a 16-MHz 68020 CPU, Color QuickDraw, and built-in 8-bit sound. However, the floppy disk drive uses the 1.44-megabyte SuperDrive, and the built-in video circuitry supports several Apple monitors. Like the IIsi, it has built-in hardware and a microphone for recording sounds.

The unique feature of the LC is its price: A system with 2 MB of RAM, a 40-MB SCSI hard disk drive, and a keyboard costs about $2400. Combine it with a low-cost Macintosh 12-inch RGB monitor ($599), and you've got a Mac II-class system with color for approximately $3000.



The Mac LC. With the 12-inch RGB monitor shown and 512K bytes of optional video RAM, it can display 16-bit color (32,768 colors).

Apple reduced the LC's cost by limiting expandability. There's no math coprocessor chip, nor are there sockets for one or for a 68851 paged-memory-management-unit chip. (You need the latter chip to support System 7.0's virtual memory or to run A/UX.) You can expand memory from the standard 2 MB to 4, 6, or 10 MB. But there's no room for another internal hard disk drive, and the machine has only a single 68020 Direct Slot. Currently, few such boards are available (Apple has an Apple II emulation board), but you can expect 24-bit color boards and an accelerator board with both a 68030 CPU and an FPU in the near future.

The Mac LC uses 256K bytes of dedicated single in-line memory module mounted-video RAM for its frame buffer. If you upgrade the video memory to 512K bytes, you get 16-bit color (32,768 colors) on the 12-inch RGB monitor, which has a 512- by 384-pixel display. Because of the separate VRAM, the LC suffers no performance penalty for using the built-in video. The BYTE benchmarks bear this out: The LC, running System 6.0.7, performs almost as well as a Mac II. Software compatibility is excellent: Our tests included putting the LC to work as a mail server for several E-mail packages.

Anyone with a need for cost-effective color should check out the LC. If your work requires only Mac II performance and color and requires little number crunching, then the LC is the machine you need.

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typing special key sequences. Finally, there is only one memory bank (four sockets) for single in-line memory module-mounted RAM, versus the two memory banks on the IIci.

Apple soldered 1 MB of 100-nanosecond RAM to the main logic board; the built-in 320K-byte video frame buffer resides here. You can expand the IIsi's memory from the standard 2 MB (which is enough to run System 7.0) up to 3, 5, 9, or 17 MB of RAM, depending on the RAM density in the memory bank. Normally, on-board video results in a performance hit, because the video circuits block the CPU when both devices access the same address space. Because Apple placed the frame buffer within the on-board RAM, CPU accesses to the IIsi's memory bank proceed unhindered.

By contrast, the IIci puts its frame buffer in one of its two memory banks. As a result, at least half of the system's memory suffers a performance hit, versus only 1 MB on the IIsi. Of course, if you don't use the on-board video, this isn't a problem.

However, the IIsi isn't just a remake of the Mac IIci. A sound input jack and 8-bit A/D converter provide built-in sound-recording capability. An electret microphone is provided, and a phono adapter cable lets you pipe in sounds from compact discs or tape. The Sounds cdev lets you record at rates of 11 kHz or 22 kHz for up to 10 seconds. You can't edit the sounds you record, though. To do that, you need an application such as Farallon's SoundEdit.

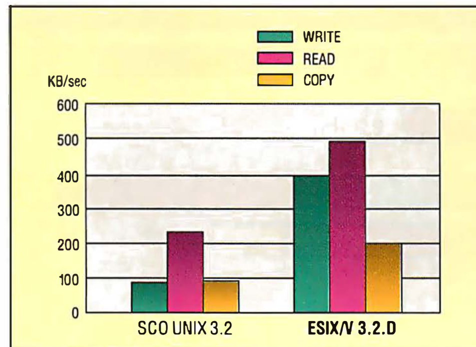
Compatibility and Performance

I expected compatibility to be good because the Mac IIci served as a proving ground for the Mac IIsi's on-board video and memory decoder circuits. However, until now a modular Mac has always had an FPU. I removed the optional FPU to see if this would create problems for applications that assume its presence.

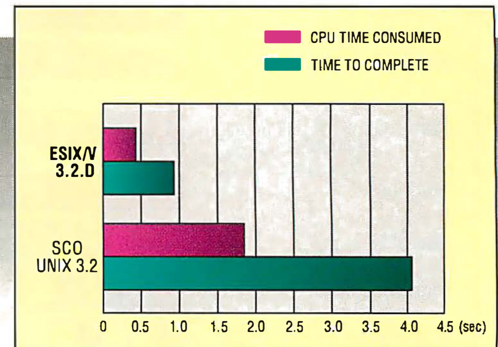
Applications such as PageMaker 4.0, Illustrator 3.0, FreeHand 2.0, Photoshop 1.0, ATM 2.0, and MacWrite II 1.1 ran and printed without a hitch. The Timbuktu 3.1 remote-control program

When Selecting Your UNIX Operating System, Consider These Facts:

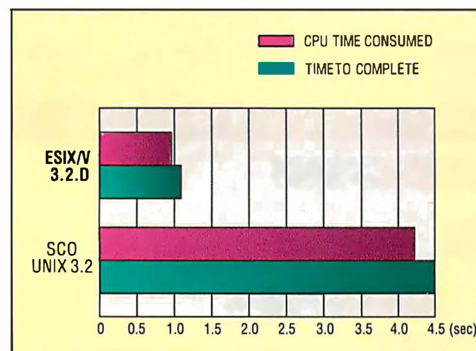
Performance*



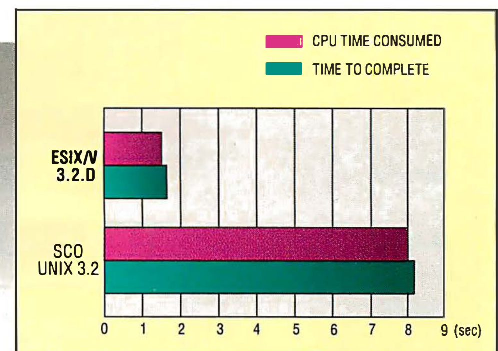
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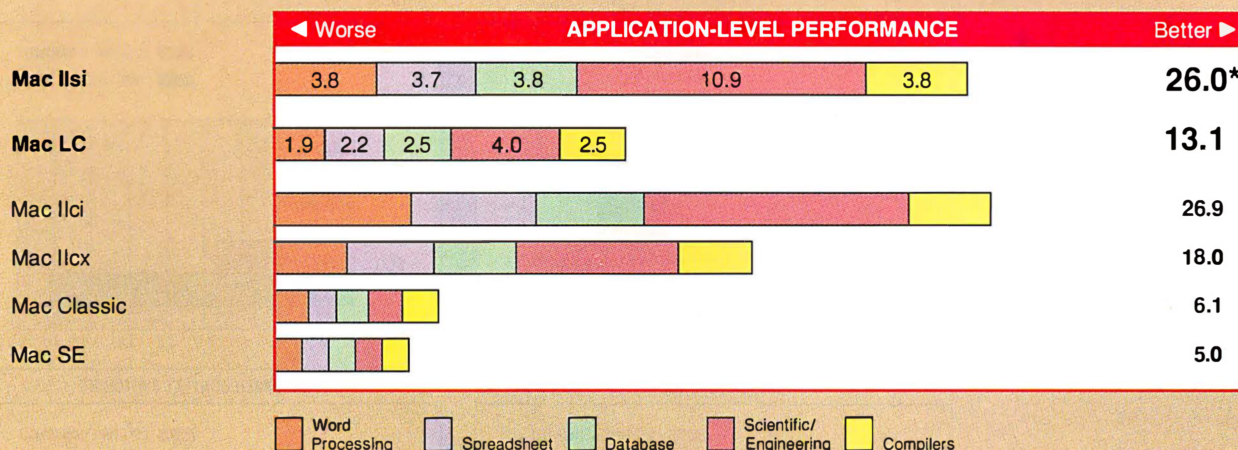
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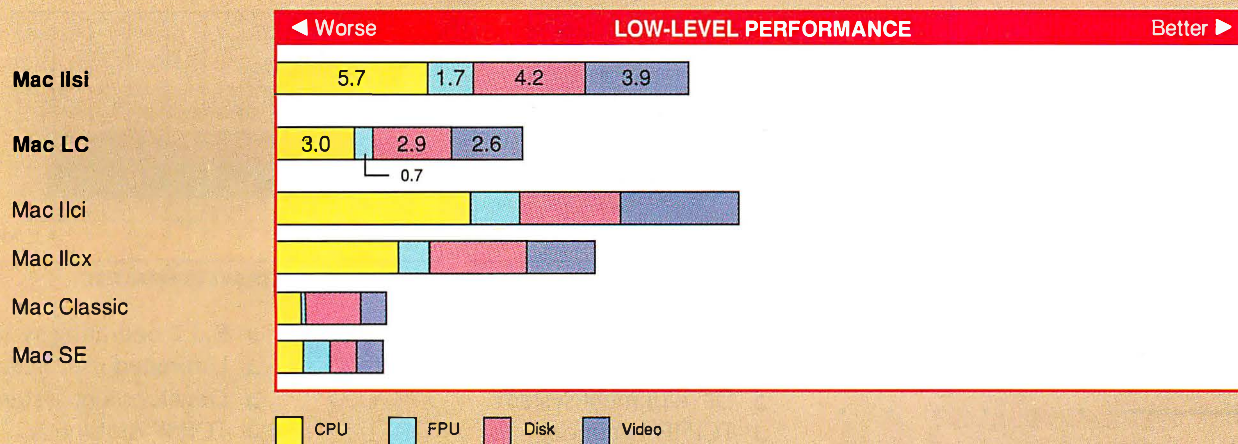


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*Based on MUSBUS Benchmark Suite on STEP 386/25, 16MB memory, Default kernel configuration, standard C Compiler, NBUF=600, NHBUF=128

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MACINTOSH BENCHMARKS





CONVENTIONAL BENCHMARKS

	LINPACK (single)	Double LINPACK	Dhrystones
Mac IIsi	194	196	4453
Mac LC	928	1790	2008
Mac IIci	150	151	5725
Mac IIcx	237	250	3735
Mac Classic	2324	4237	806
Mac SE	2319	4229	805

Except for the conventional benchmarks, all results are indexed; for each test, a Mac SE = 1, and higher numbers indicate faster performance. In the Dhrystone test, higher numbers indicate faster performance; in the LINPACK tests, lower numbers are better. The floating-point benchmarks use the SANE library. Comprehensive test results for all tested machines are available on request. For a full description of the Mac benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE.

from Farallon Computing also worked readily. The IIsi's apparent performance seemed brisk enough, even compared to the IIci that I normally use.

Most spreadsheet programs had problems with the absent FPU. Excel 2.20 crashed when I opened a spreadsheet file (version 2.20a corrects this problem). WingZ 1.1 displayed an alert box stating that a 68020 and a math coprocessor weren't present—right on both counts—and then exited gracefully to the Finder. To my surprise, graphics applications, such as PixelPaint Pro 1.0 and PhotoMac 1.52, experienced the same problems. Most vendors have new versions that work fine.

I ran the BYTE benchmarks on the IIsi using a 640- by 480-pixel AppleColor RGB monitor—the same monitor I used when benchmarking the 16-MHz IIcx and 25-MHz IIci. I have also included benchmark results for the Mac LC (see the text box "The Mac LC: Low Cost, High Quality" on page 258) and the Classic—Apple's two other low-end machines.

As the BYTE Lab test results show, the Mac IIsi performance falls squarely between that of the IIcx and the IIci. Without the FPU, however, math processing performance sags to around that of a Mac II. The FPU reduced math test times by 40 percent to 50 percent on average. If you plan to do serious digit bashing with this machine, you should spend the extra $249 to obtain the FPU/expansion board adapter.

The Limits of Power

Apple performed some high jinks to fit a PC form-factor NuBus board inside the IIsi. The NuBus adapter, which contains both the FPU chip and the NuBus logic circuitry, is an L-shaped contraption that places the board on its side within the IIsi chassis. It's the darndest thing you ever

saw, but it works. I put a Radius TPD Interface board inside the IIsi, and it drove a 21-inch Radius monitor just fine.

The IIsi's 47-watt power supply is considerably smaller than the IIci's 90-W unit. Exceeding power limits can overheat the Mac or damage the power supply, so IIsi owners should select their NuBus boards and peripherals carefully. To meet Apple specifications, NuBus boards shouldn't exceed 15 W; 030 Direct Slot boards should require no more than 7 W. Not all boards fall within this limit. All RasterOps video boards comply, as does the Radius DirectColor/GX. Ironically, Apple's own 8•24 GC accelerated video board exceeds the specification: It requires 20 W. Combine the 8•24 GC with a second internal hard disk drive and you just might break the IIsi's power budget.

If Apple's 40- or 60-MB hard disk drive isn't enough, Rodime offers a one-third-height unit—the 100-MB Cobra 100il ($1869)—that mounts above Apple's hard disk drive. Installation is a tad convoluted, but the 100il works reliably and shouldn't overburden the power supply if your NuBus or 030 Direct Slot board is within specification. Alternately, you can add external SCSI peripherals that won't tax the IIsi's power supply.

Is It Right for You?

Will the IIsi do the job for you? If you want to run some 8-bit color applications and you're happy with a small screen and the processing power of a Mac II, the $3000 Mac LC is a better choice. You should go with the IIsi if you demand number crunching, or a big screen, or a fast network connection—but not all of the above. The IIsi's 68030 CPU provides plenty of computing horsepower, and its integral memory management unit lets you use all of System 7.0's features or run A/UX 2.0.1, Apple's version of Unix.

The Mac IIsi's expansion capabilities, limited as they are, provide some choices that you won't get with the Mac LC. On the other hand, if you need 24-bit color *and* Ethernet connectivity, you need the Mac IIci.

The IIsi is now Apple's entry-level Mac II computer, and its most innovative feature is its reasonable price. Coming from Apple, that's a welcome development. ■

Tom Thompson is a BYTE senior editor at large. He has a B.S.E.E. degree from Memphis State University. He can be reached on BIX as "tom_thompson."

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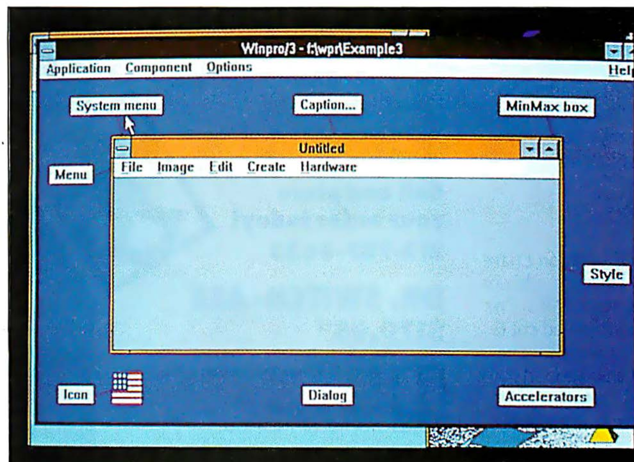
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Winpro/3's interface editor permits interactive design of Windows program interfaces.

BYTE ACTION SUMMARY

WINPRO/3

- **WHAT WINPRO/3 DOES**
  Winpro/3 is a user interface editor for Windows programmers. Instead of specifying the size and placement of various objects manually, you can construct the screen in a WYSIWYG fashion.

- **WHAT YOU'LL LIKE**
  Winpro/3 saves programming time and improves the quality and appearance of interfaces. You see a working prototype of your interface in hours instead of days.

- **WHAT YOU'LL DISLIKE**
  The product doesn't save you from having to learn Windows programming; the C source code produced by Winpro/3 must be heavily modified before use. The cost will probably keep casual users at bay.

- **SYSTEM REQUIREMENTS**
  PC capable of running Windows 3.0 in protected mode (286 or higher); Windows 3.0; Microsoft Windows SDK; Microsoft C or other Windows-compatible C compiler

- **WHAT YOU'LL PAY**
  $895

- **FOR MORE INFORMATION**
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  Ridgewood, NJ 07450
  (201) 447-3270
  fax: (201) 447-2547

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Even with all the copies of Windows 3.0 out there, programmers still wince when faced with writing Windows applications. The Windows interface is not known for its friendliness to developers, and the standard Software Development Kit (SDK) offers no relief from the burden of laying out interfaces by hand. Microsoft seems content to leave the simplifying of Windows development to third-party companies.

One third-party solution, Winpro/3 from Xian, should be welcomed by developers. Winpro/3 is an aid to Windows programmers. Basically, it rides herd on your resource files. It also automates a lot of the busywork involved in setting up a new application. In simplest terms, it is an application builder, letting you lay out interfaces by dragging the elements into place. You can alter the appearance and details of the sample application window by clicking on the various labels. And the menu on the sample window actually works, so you can see how the main menu and pop-up menus look. In addition, you can link a menu choice to a dialog box (by giving them both the same ID), so choosing that menu choice brings up the linked dialog box. You can also view any of the dialog boxes in the program by choosing from a list presented when you click on the dialog-box label.

Besides giving you an advance look at your interface's appearance, Winpro/3 also manages all the application's resources. It contains a string resource editor and an accelerator key editor, and it runs the various editors (e.g., the ones from the SDK or whatever program you specify) for other resource types. Almost everything is maintained in one resource source file, with an include file for the icon.

Winpro/3 shows you your resources as they actually run, which is easier than analyzing the source code. It helps start a new program by importing resources from other programs, managing the edit process, and collecting everything together into one resource file.

Windows Done Easily

Winpro/3 comes on two 5¼-inch disks or one 3½-inch disk. There is no formal installation process; you just copy the files. However, you then have to edit the templates to fill in the correct name of the library you want to use, and you must uncomment a line if you are using the NMAKE program instead of the old MAKE program.

The manual comes in a full-size ring binder. The main application instructions make more sense after you have worked with the program; that is, you have to get a feel for what the program does before you read the details about menu choices and so on. There is a section on the template language, and one on the code regeneration algorithm. All in all, the documentation is pretty good.

Most of Winpro/3 involves working with the layout editor. You simply place elements where you want them and tag them with the attributes you desire. Once you have everything the way you like it, you just pull down the Applications menu and choose "Generate Code. . . ." Winpro/3 will generate C code, including initialization code that registers the class and creates the main window, dialog

functions for all the dialog boxes, and a header file for your resources. It also creates a make file, a linker response file, and a linker DEF file.

The creation of the dialog functions is probably the best feature. The sample application had quite a few dialog boxes, and the generated C source code was well over 60K bytes long just for the dialog functions. Winpro/3 also creates the main event loop and takes care of calling dialog boxes from linked menu choices.

Winpro/3 generates a good deal of skeleton code in a few seconds, saving the programmer a tedious and error-prone task. But programs tend to change after they're designed. After you start fleshing in the skeleton, you can change the resources and window appearance and have Winpro/3 regenerate the files without messing up what you've added.

Potential Time-Saver

Winpro/3 is flexible. It supports custom-control styles in dialog boxes. The names of the various programs it can call are configurable, as are the names of the files that are generated. The generated code is based on a skeleton file, which can be edited. You can easily retouch the file for your own formatting styles or make radical alterations to the code.

Winpro/3 has a few shortcomings, however. Control over the window class definition is not complete. You will most likely need to retouch the code to specify the proper style of flags and background brush, and you'll have to change the cursor if you want anything other than the normal IDC_ARROW.

The code generated from the template is well commented, so you can easily locate a particular code segment. The code is organized into blocks, with each block marked by comments. Changing the word *regenerate* to *preserve* in a block comment will prevent that block from being updated when the code is regenerated. Blocks can be nested, so you can control an entire function or just a particular branch within it. For example, assume that you've retouched the window-class definition code. You would flag it as "preserve" so your changes will not be clobbered when you regenerate due to, say, changing a dialog box.

In short, Winpro/3 is handy. The $895 price tag is a bit daunting for an individual, but it should be within the budget of a programming shop. And it can save you a lot of time. ■

John M. Dlugosz is a programmer, writer, and consultant based in Plano, Texas. He can be reached on BIX as "jdlugosz."

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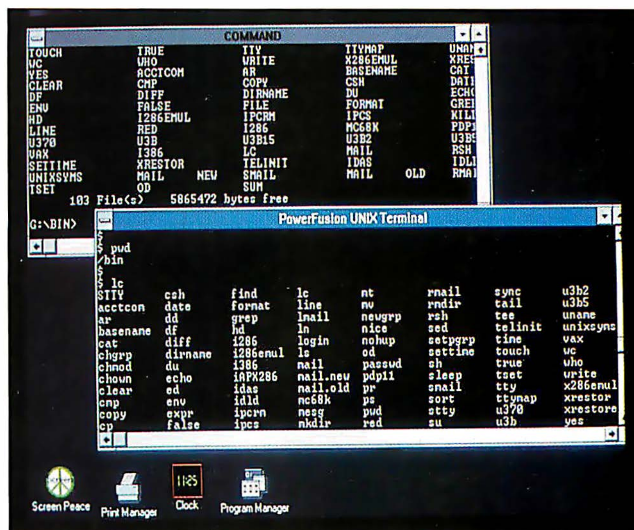
JON UDELL

What's the best way to connect Unix and DOS networks? It depends on your point of view. According to the Unix-centric perspective, DOS machines need only run the TCP/IP protocols (and related tools) to enjoy the file, print, and terminal services of a Unix LAN. Of course, Unix folk tend to underestimate the strain that puts on a puny DOS workstation—particularly one that is also running as a node on a DOS LAN.

The alternative DOS-centric view therefore holds that Unix should pretend to be a DOS-style LAN server. The DOS LAN protocols already running in the PC do double duty, providing the ticket to Unix services as well. That's how Performance Technology's Powerfusion works: A Server Message Block (SMB) file server runs under Unix, communicates through NetBIOS (over ARCnet or Ethernet), and delivers file and print services to DOS clients. At the same time, a NetBIOS-oriented terminal server running on the Unix host, coupled with a DOS-based terminal emulator, enables DOS clients to run Unix terminal sessions at network speed.

That's fine for PC LAN, LAN Manager, or other DOS LANs that use the SMB and NetBIOS protocols, but what about NetWare, which doesn't? One approach is to multiplex protocols on the PC. CocoNet, the Xenix-to-DOS product from Atlantix, uses packet driver technology to toggle between NetWare's IPX and a custom NetBIOS that communicates with Xenix-Net.

Performance Technology takes a different tack. NetWare clients run Novell's own NetBIOS emulator, which uses IPX. One nondedicated node on the NetWare LAN runs a NetBIOS-to-NetBIOS converter, called Powerbridge, that joins the NetWare NetBIOS to the Unix NetBIOS (see the figure). Either way, the NetWare client must also run an SMB-oriented redirector to use the file and print services offered by the Unix (or Xenix) SMB server. Powerfusion provides a reasonably small (15K-byte) redirector that does the job nicely.



Two views of the Unix /usr/bin directory from Windows, using Powerfusion's terminal emulator and SMB redirector.

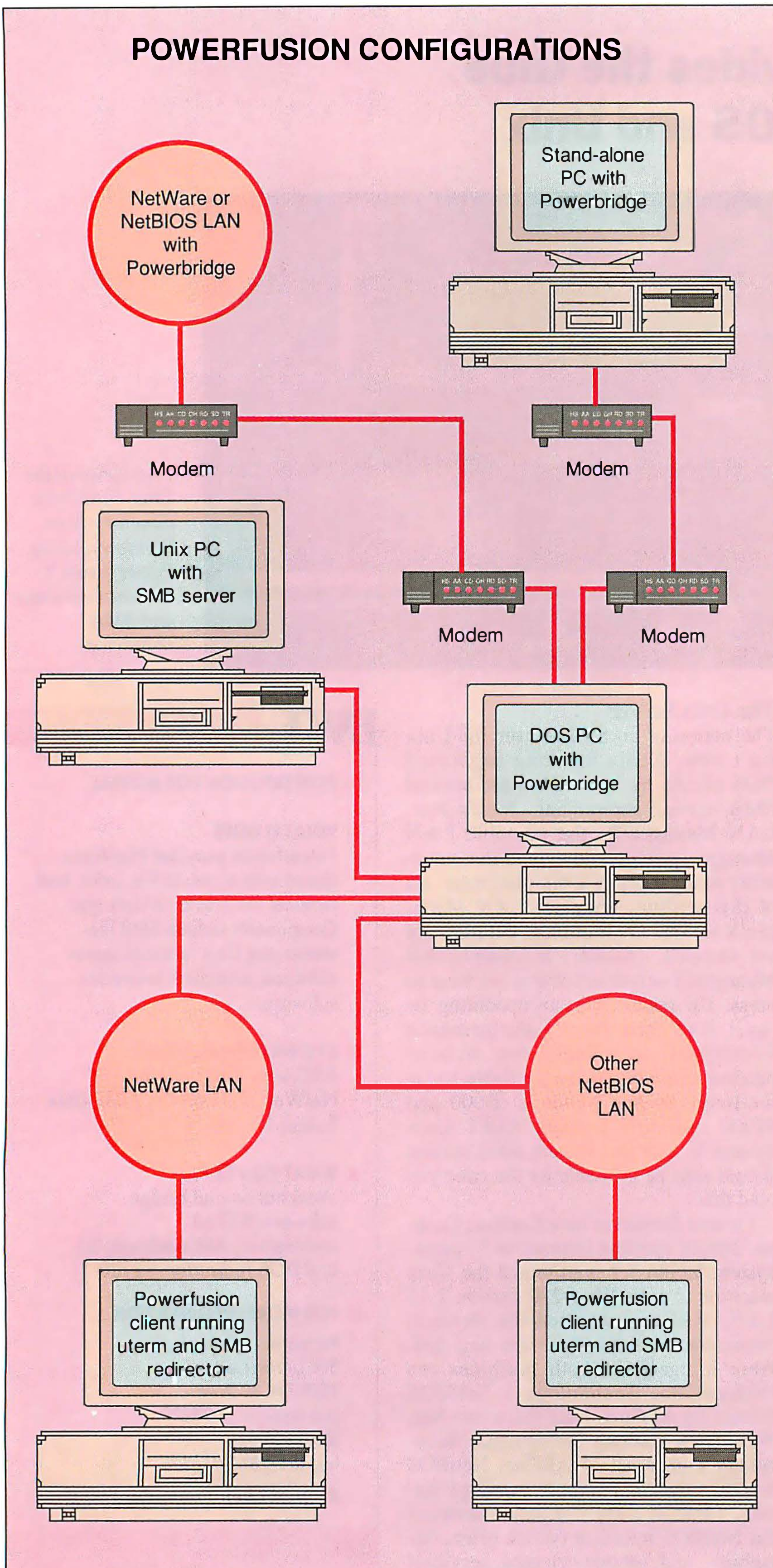
The Unix Server

The notion of an SMB server for Unix isn't new. Xenix has long supported DOS clients by way of a little-noticed SMB server component, Xenix-Net. LAN Manager/X, the portable LAN Manager, promises to extend that capability to a variety of Unix platforms. As of this writing, however, LAN Manager/X servers are imminent but have not yet shipped. (Atlantix's Axcess LAN Manager/X server arrived as we went to press. I'll review it in an upcoming issue.) And then there's Performance Technology's own SMB server, an independent implementation available today for Intel 386 and Motorola 68000 and 88000 machines running AT&T Unix System V. A RISC System 6000 version should also be available by the time you read this.

I tested the server on a Compaq Deskpro 386SX running Interactive Systems' System V/386 3.2, and joined the Unix machine to a NetWare 286 version 2.15 LAN. ARCnet provided the physical connection between the Unix and NetWare bridge PCs; both machines ran Performance Technology's NetBIOS drivers for ARCnet. Note that a non-NetWare LAN running Performance Technology's Ethernet or ARCnet NetBIOS drivers might not require a bridge station. There is a key distinction between the NetBIOS interface (which offers datagram- and session-oriented services)

BYTE ACTION SUMMARY

- **POWERFUSION FOR NOVELL**
- **WHAT IT DOES**
  Powerfusion provides NetWare clients with access to file, print, and terminal services on a Unix host. Components include SMB file-server and Unix terminal-server software, and client redirector software.
- **SYSTEM REQUIREMENTS**
  ARCnet or Ethernet LAN; NetWare 2.1x or 3.x; AT&T Unix System V
- **WHAT YOU'LL PAY**
  Workstation and bridge software: $1750
  Unix server, ARCnet/NetBIOS, and DOS redirector: $2250
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Performance Technology's Powerfusion and Powerbridge provide several types of network connections. At the heart of the system, a Unix PC running SMB file-server software and NetBIOS delivers file and print services to DOS clients by way of a nondedicated bridge PC. The bridge PC translates between different NetBIOS versions on the client and host machines. Meanwhile, a NetBIOS-oriented terminal server running on the Unix host, coupled with a DOS-based terminal emulator, enables DOS clients to run Unix terminal sessions at network speed. Powerbridge's serial communications option bridges to another NetBIOS LAN or a stand-alone machine using a modem or X.25 PAD. The stand-alone PC uses a special "null NetBIOS" program to route NetBIOS requests through a modem to the SMB server by way of the Powerbridge PC.

and the underlying transport protocols that support that interface. Both must be compatible for plug-and-play interoperability.

According to Performance Technology, its selection of Ethernet and ARCnet drivers for Unix, DOS, and OS/2 can help close the "transport gap." The company claims (although I didn't test this scenario) that a 3Com or CBIS LAN running Performance Technology NetBIOS drivers in place of its own could access the Unix server directly. In the case of a LAN whose NetBIOS is not substitutable—LANtastic is an example—you'd use a bridge just as with NetWare.

The Unix script that starts `PCserve`, the SMB file server, also fires up a daemon that provides "get and put" file transfer services. Together, these two components publish NetBIOS names that Powerfusion's DOS utilities can then use to access terminal, printer, file sharing, and file transfer services. You can use the `nbas` (NetBIOS adapter statistics) program to list the names installed in the NetBIOS name table.

The configuration tool, `PCconfig`, works like a typical Unix system administration utility—not fancy, but it gets the job done. You use it to establish sharenames for disk and printer resources, and to specify how those resources will appear to DOS clients.

The server offers two general forms of security, which are dubbed "MS-DOS" and "Unix." These correspond roughly to LAN Manager's "share" and "user" modes. With MS-DOS security, users get access to all files in the shared directory; with Unix security, clients take on

a Unix user ID, and all subsequent access is governed by Unix's three-part user/group/other scheme. In either case, you've got to associate a Unix user ID and group ID with the sharename, and these IDs ultimately determine the effective permissions. The Unix-oriented scheme offers more flexibility, at the cost of some extra administrative overhead. To make the best use of it, Performance Technology recommends that you set up a group ID for each shared resource, and related user IDs for all DOS users.

Shared disk resources can be password-protected, but need not be. There's also a synchronous write option. That means you can choose, for each shared resource, whether or not to use the Unix disk cache. It's a simple trade-off: You use the cache when speed matters most, but you can bypass it when reliability is critical.

You can also use `PCconfig` to make the Unix `lp` (line printer) spooler available to DOS clients. Each shared printer resource can carry a set of options that feed into and control `lp`. These options include the name of the destination printer and the method used to notify the user when the job is finished (i.e., a direct TTY message or mail message). When you quit `PCconfig`, it asks whether you want to signal the `PCserve` process to make the changes take effect immediately. Clients that are actively using resources don't see the changed configuration, I found, until they free the resources and make new connections.

My biggest disappointment took place when I installed TCP/IP on the server, intending to connect it to BYTE's Unix Lab network. Had that worked, I'd have been able to establish terminal sessions with any of the machines in the Unix Lab from any PC on the LAN. Unfortunately, the TCP/IP and ARCnet/NetBIOS subsystems refused to play together on the Powerfusion server. Performance Technology acknowledges the problem. The company claims that it only affects current versions of Interactive Systems' Unix, and that TCP/IP and Powerfusion do coexist peacefully under SCO Unix and the other Unixes that Powerfusion supports.

Tools for the DOS Client

Performance Technology offers a basket full of utilities on the DOS side, along with a couple of shells to help coordinate them. At a minimum, though, you need only run `uterm` on top of NetBIOS to open a terminal into Unix. It supports ANSI and VT220 emulations, and it's a snappy performer. Running `vi` through `uterm`—over Ethernet to the NetWare bridge station, and thence over ARCnet to Unix—didn't seem much different from running `vi` on the Unix console. It's got a handy shell-to-DOS feature so you can suspend `uterm`, run a file transfer, and then resume your terminal session.

File transfer utilities are the command-line-oriented `uput` and `uget` and the interactive `ucopy`. These tools operate relative to a default Unix node, user name, and password drawn from a configuration file. In my case, for example, the command

```
uput c:\autoexec.bat
```

deposited that file in my Unix home directory, `/usr/judell`. You can override these defaults with command-line arguments to `uput` and `uget` or by means of the menu that `ucopy` presents. If you

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specify that a file contains text, the tools will convert between Unix (linefeed only) and DOS (carriage-return, linefeed) formats.

But why bother with file transfer when you can use Unix files directly? Powerfusion's redirector costs only 15K bytes. Once it's loaded, you can map a local drive to the Unix file system in the following manner:

```
net use d: \\UNIX386\judell
```

Then you use the DOS `copy` command to ship files around. The `net` command will be familiar to users of almost any NetBIOS LAN. In this case, `UNIX386` specifies the NetBIOS name of the SMB server, and `judell` is a sharename that is mapped to the `/usr/judell` directory. Note that the Unix server can't advertise the resources it publishes, so an administrator has to tell users what sharenames are available and how they're intended to be used.

With the interactive `navigate` utility, you can browse local, NetWare-resident, and Unix-resident directory trees, create and delete Unix drive mappings, and search for files. Finally, there's an umbrella utility, `pfn`, that unifies all the subsidiary tools.

Documentation for the tools is adequate in some cases but, unfortunately, nonexistent in others. I found no mention of several key components, including `net`, `redir` (the redirector), `plnetnam` (a NetBIOS name table initializer), and the PC version of `nbas`. Powerfusion gets cranky when you don't use these tools, or don't use them in the right order, so there ought to be some explanations.

NetBIOS Bridge Building

The Powerbridge toolkit from Performance Technology reminds me of the Swiss Army knife: There's a gadget for almost every conceivable purpose. In the simplest case, it straddles two NetBIOSes and hides differences between underlying transport protocols. For example, my test system's bridge machine booted with two adapter/NetBIOS pairs: Ethernet with Novell's NetBIOS, and ARCnet with Performance Technology's NetBIOS.

In that scenario, the bridge software publishes NetBIOS names from the Unix-connected adapter to the NetWare-connected one. A NetWare client that is requesting terminal or file service on the Unix machine won't find the relevant NetBIOS name in its table, but the bridge silently passes the request through to the Unix-connected NetBIOS. The bridge PC itself remains a functional—if somewhat diminished—NetWare client. In my case, the two sets of drivers took up about 100K bytes, and the bridge used another 100K bytes. This left about 320K bytes free.

Using an interactive tool referred to as `bridge`, you name the adapters and specify the flow of resources among them. (The flow can be bidirectional, but it wasn't in my case, since a NetWare LAN publishes no resources that SMB clients can use.) The `bridge` tool gathers information and writes a batch file that deploys the actual bridge utilities—one to start the bridge and one to initialize adapters and cross-publish resources.

The process is simple—but deceptively so. Once you see how it is done, it makes sense, but `bridge` will just as happily write meaningless configurations. It doesn't know, for example, that a quirk of NetWare's NetBIOS requires that you allocate an additional "null adapter," or that a NetBIOS name you specify might

not actually exist in the relevant table. Better documentation would be a great help and, according to the company, should be available by the time you read this.

Things get even more interesting when you tap into Powerbridge's (optional) serial communications capability. With it you can bridge a pair of NetBIOSes separated by an asynchronous connection. One of these can be a stand-alone machine, or you can connect two NetBIOS LANs. I tested the stand-alone case using a "null NetBIOS" program provided by Performance Technology. The stand-alone machine ran the null NetBIOS and a bridge configured to route NetBIOS requests through a modem. To the bridge already running on the NetWare LAN, I added the corresponding modem-to-NetBIOS magic. Somewhat skeptically, I then typed

```
net use d: \\unix386\judell
```

and, well, you haven't lived until you've seen a stand-alone PC request an MS-Net-style drive mount, reach across a 2400-bps serial connection, and then hop through a NetWare LAN to an SMB server running under Unix. It worked like a charm: The connection, while obviously slow, was perfectly serviceable. If you find this sort of wide-area connectivity appealing, note that the very same bridge software can link NetBIOS LANs over X.25.

Pieces of the Internetworking Puzzle

Powerfusion's chameleon-like nature makes it a bit hard to describe adequately. When you get right down to it, Performance Technology is selling glue technology that can help solve a variety of local- and wide-area networking problems. Lord knows, that's something we all need.

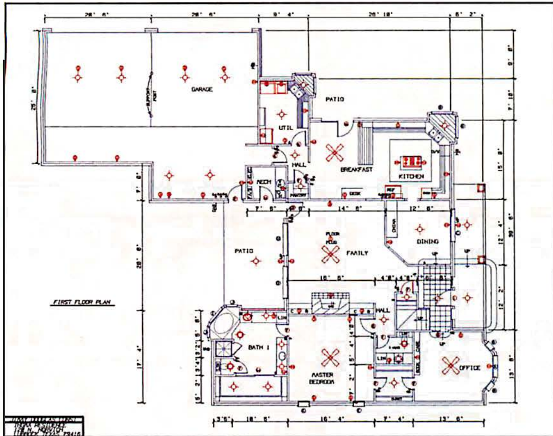
The Unix server is one key component. While Unix would not be my first choice for a sole DOS file server—I much prefer the administrative facilities of NetWare or LAN Manager—it is a handy auxiliary server. Here's one interesting scenario: Locate database files used by a DOS-based DBMS on the Unix machine and then export access to those files to Unix clients (local or remote) by means of a Unix terminal-oriented application.

Powerbridge is another key piece that savvy systems integrators will want to be aware of. Interestingly, the company says that by the time you read this, it will have eliminated the bridge requirement for Novell-to-Unix arrangements like the one I tested. Given a common topology, a Performance Technology replacement for the Novell NetBIOS should eliminate the need for a NetBIOS-to-NetBIOS converter. Even if that should happen, however, Powerbridge will remain a valuable tool for connecting NetBIOS LANs locally or through asynchronous or X.25 links.

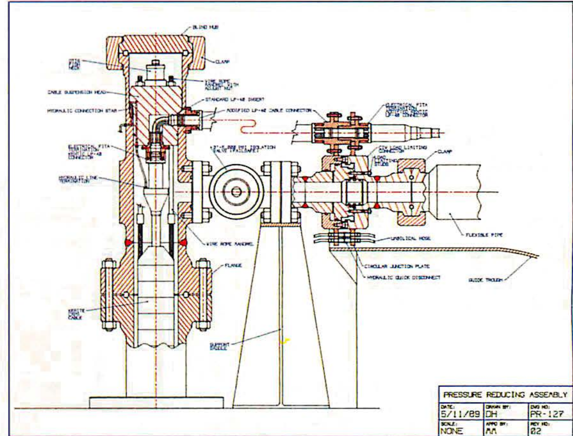
I can't say that Powerfusion made everything painless. While it's fair to expect that DOS and Unix internetworking will entail some rocket-science-like technology, the Powerfusion toolkit could certainly benefit from cleaner organization and better documentation. But if you think that TCP/IP is the only game in town, think again. Performance Technology makes NetBIOS a workable alternative. ■

Jon Udell, a BYTE senior editor at large, administers BYTE's editorial LAN and manages the LAN Lab. You can reach him on BIX as "judell."

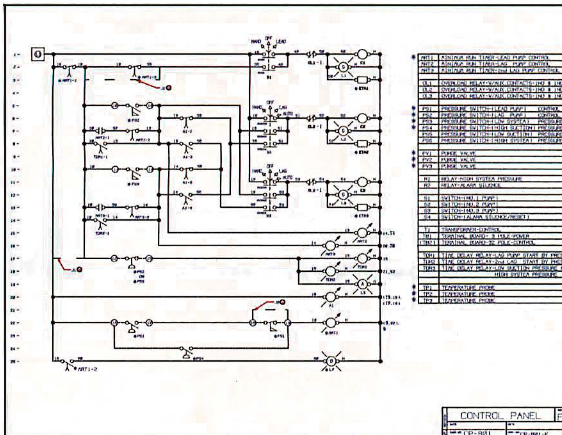
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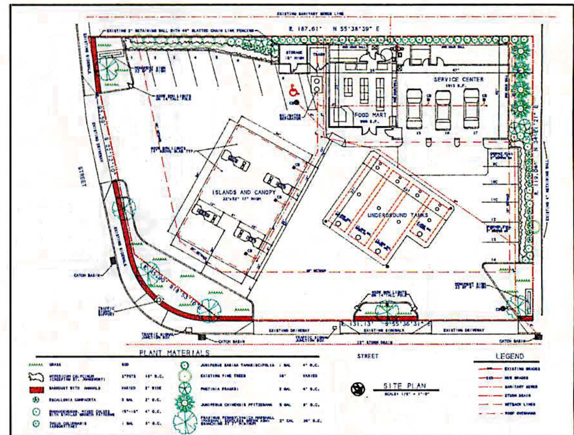
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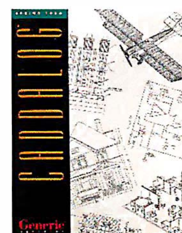
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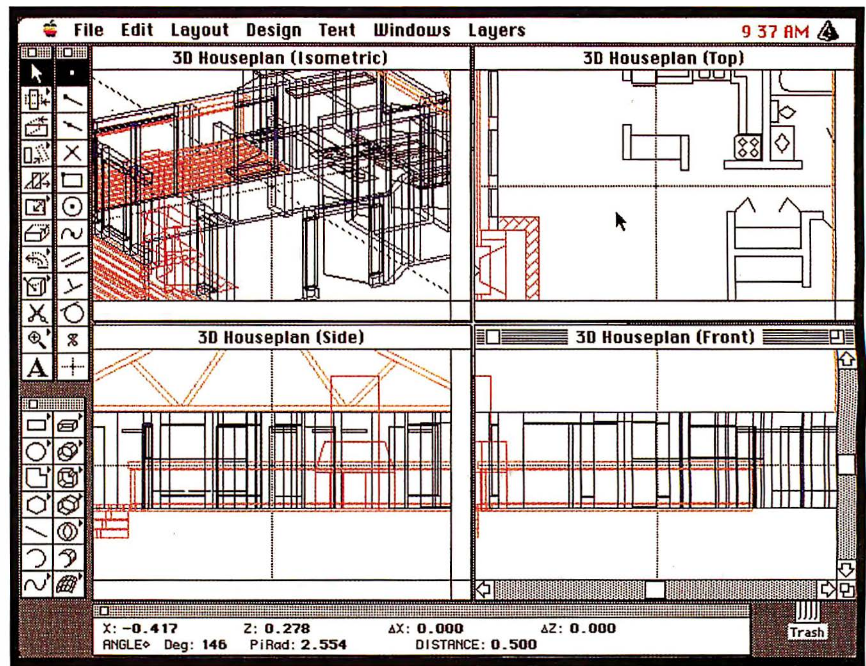
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APPLICATIONS

2-D and 3-D Mac CAD for Less Cost

BILL CALABRESE



DesignCAD Macintosh's four main windows operate interactively while displaying 3-D space. A fifth window (not shown) lets you rotate 3-D models in real time.

DesignCAD 2D/3D Macintosh 2.3 gives Mac-based designers and engineers a fast tool for two-dimensional drafting and 3-D modeling. Along with its relatively low cost of $699 come a few warts, but not enough to steer you away if your CAD work consists of small to moderate-size projects.

DesignCAD supports A/UX and provides 32-bit floating-point accuracy. Its 3-D features include built-in shading, with both smooth shading and specular reflection using ray casting. Specular reflection makes smooth objects appear glossy, and specular highlights created by the light source can be reflected off the image to add realism. Also, DesignCAD rotates drawings in real time and transfers drawings to and from most of the common file formats, such as DXF, IGES, HPGL, and PostScript.

Version 2.3 is the revised and renamed Origins, from Deltasoft. DesignCAD, Inc., purchased the technology a year ago and introduced the newest version late last year. The company markets the program as the first microcomputer-based CAD package that describes all geometry via a single, unified mathematical parametric representation (see the text box "Wire Frame to Solid: One Database Fits All" on page 278).

In part, this approach produces smaller files, because you can describe every CAD entity with a single equation. For example, I created an 18K-byte model in Dynaperspective 2.0.2, saved it as a DXF file, and translated it into DesignCAD. The DesignCAD file was only 1K bytes. Also, DesignCAD is much faster for manipulating objects, such as primitives, in the 3-D window than VersaCAD/Macintosh Edition 3.0 or Dynaperspective. (But the speed advantage

disappears rapidly as the file size increases.)

The unified cubic spline and unified bi-cubic surface geometry in DesignCAD make it possible to produce local modifications to any line, curve, or surface, regardless of an object's complexity. This means that you can modify a single line of a solid object or resculpt a surface and have the change reflected throughout the object without needing to redraw it.

Installation Ease

Installation was simple. I just created a file on my hard disk drive and copied the application and companion files into that file. DesignCAD requires approximately 3.6 megabytes of disk space. I ran the program on two systems. One was a Mac IIx originally with a DayStar 50-MHz accelerator, 8 MB of RAM, 1 gigabyte of storage, and a 19-inch Radius color monitor. The second consisted of a Mac IIcx with 8 MB of RAM, an 80-MB internal hard disk drive, and an Apple 13-inch color monitor. Both systems ran System 6.0.5 and 32-Bit QuickDraw 1.2.

The program includes DesignCAD Exchange, an application you use to translate files between common file formats. In theory, it works very simply: The dialog box shows two columns of file formats; just click on the radio button adjacent to the file format you wish to translate and again on the radio button adjacent to the new file format. However, I had several problems with the application. The first was its inability to translate large files. I tried to transfer a 360K-byte AutoCAD DXF file, and a warning box told me that the application needed more memory. I increased the application's memory allocation to 4 MB but got the same warning. I progressively reduced the size of the files being translated and finally got Exchange to translate a 180K-byte VersaCAD/Macintosh 3.0 DXF file into DesignCAD.

Opening the DesignCAD application brings onto the screen four windows (perspective, top, side, and front), all of which operate interactively. DesignCAD automatically reflects the object you manipulate in one window in the other three windows. It is important to remember that although DesignCAD's windows look like "flat" views, they actually display 3-D space. In other words, the lines and objects that you see in the three plane and elevation views do not all exist on the same plane but are instead located in various planes from front to back.

From the menu, you can open a fifth window called Dynamic View, which you use for rendering and 3-D model manipulations such as walk-throughs and rotations. The Dynamic View tool palette lets you rotate and manipulate your 3-D model in real time.

Faithful GUI

The toolboxes include Editing (which is not intuitive: you'll need to refer to the manual frequently for this one); Locator (again, not easy to understand); Dimensioning (both 2-D and 3-D primitives); and Readouts (this palette tells you where you are in 3-D space). The tool palettes are not as intuitive or as easy to use as the VersaCAD/Macintosh program, and DesignCAD unfortunately doesn't offer online help menus. Help menus should be interactive with all programs, especially complex CAD applications.

Drawing is easy using the click-drag-release method, although this seems to be less refined than the click-and-click method used by higher-end CAD programs like VersaCAD. I found drawing with the primitives on the DesignCAD palette to be simple and straightforward. Half of the palette contains 2-D tools, and the other half 3-D tools.

I easily created basic 2-D and 3-D drawings within a few minutes of opening the program simply by playing with the tools. I created a 3-D rectangle with one bowed side in less than 2 minutes. I opened DesignCAD and selected the solid rectangle tool. On the front elevation, I clicked, dragged, and released with the mouse to create two hollow rectangles. Using the Spline Editor tool, I clicked on the line I wanted to bend, dragged the mouse, and released the button when the curve was positioned correctly. Most of the tools work this simply, although, at first glance, their function wasn't always obvious.

The program's overall ease of use stems from the fact that it faithfully follows the Mac's graphical user interface. That's handy, since the hefty manual that comes with the program needs some work. Many menu items, tool descriptions, and procedures are hard to follow. I also found references to nonexistent chapters in the manual. Incredibly, nowhere does the manual say that you must have System 6.0.5 and 32-Bit QuickDraw 1.2 installed (however, both are included with the program). If you don't run them, the program will bomb continually. DesignCAD also ships a minuscule quick reference guide and tutorial, which are worthless. That's too bad, because users definitely need a good tutorial to guide them through the complexity of working in 3-D space.

Other Imperfections

In addition to poor documentation, DesignCAD has several other problems. It wouldn't expand the active window to accommodate my 19-inch Radius monitor, but instead kept the window's size as if it were on a 13-inch monitor. Also, DesignCAD crashed every time I tried to run it with my DayStar 50-MHz accelerator.

As mentioned earlier, I did transfer a VersaCAD 3.0 file into DesignCAD, but I found the file hard to work with. The program slowed considerably, and many tools had difficulty operating on the drawing. The inability of DesignCAD to

BYTE ACTION SUMMARY

DESIGNCAD 2D/3D MACINTOSH 2.3

WHAT YOU'LL LIKE
Speed, simplicity, and low cost for small to medium-size drawings and models.

WHAT YOU'LL DISLIKE
The program's poor documentation, its inability to accommodate monitors bigger than 13 inches, and difficulties translating large files.

SHOULD YOU BUY?
Yes, if your designs aren't too large or complex and once the company fixes some problems (DesignCAD promises revisions by the time you read this).

SYSTEM REQUIREMENTS
Mac with at least 1 MB of RAM and a hard disk drive; a math coprocessor is recommended

SOFTWARE REQUIREMENTS
System 6.0.5 and 32-Bit QuickDraw 1.2 (both are included with the program)

WHAT YOU'LL PAY
$699

FOR MORE INFORMATION
DesignCAD, Inc.
327 South Mill
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fax: (918) 825-6359

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Wire Frame to Solid: One Database Fits All

Alan Joch

DesignCAD 2D/3D Macintosh 2.3 brings to Mac CAD unified parametric mathematics to define object geometries. This method, which underlies some mainframe-based CAD programs, uses a single parametric equation, rather than a collection of equations, to define geometric objects. As a result, wire-frame, surface, and solid models are integrated within a single database, so the same program can produce each type of model to speed designs and maintain precision through each stage. The downside is the computational intensity of this approach.

Traditional CAD programs that use nonparametric routines require a circle equation to create a circle, a line equation to create a line, and so on. DesignCAD defines all objects as either cubic splines or, by extension, bi-cubic surfaces. Accordingly, a circle as defined by cubic splines consists of four curves; a line consists of a curve without tangents.

In practice, the underlying mathematics are transparent to users, who interact with the software using familiar tools and icons.

A designer can define a straight line and then insert a bend anywhere along the line without forcing the program to change geometric equations. Likewise, designers can warp curves, change surfaces, or introduce other changes without redrawing the object. Also, the parametric equation requires fewer points to define objects than traditional geometric representations, so file sizes are smaller.

Because the same program can produce wire frames, surface models, and solid models, designers don't have to switch to three different programs—and three different geometries—for each model type.

For example, an automobile designer typically would convert a clay model into a wire frame in a traditional CAD package, then switch to a surface-modeling program to build a shell, and then transfer the design to a third program in order to produce a solid model. Different geometry comes into play at each transition, and degradation of the design can occur. CAD programs using parametric representations can create models using the same database as the design progresses from a wire frame to a solid.

Alan Joch is a BYTE technical editor. He can be reached on BIX as "ajoch."

translate large files and the difficulty in operating within a 180K-byte translated file indicate a fairly low (and therefore less complex) operating range for this program. The company says it is aware of the monitor and file transfer problems and plans to offer solutions by the time you read this. It also plans to ship a videotape tutorial with future copies of the software.

With the bugs worked out and a good tutorial included, DesignCAD could be a hot CAD program for designers and engineers who don't work on large, complex projects. It's a very fast, easy-to-use program for relatively simple modeling procedures, such as a small house or mechanical object. VersaCAD/Macintosh 3.0 is easier to use and more detailed for 2-D CAD drawings that are more complex than a simple residential building. Dynaperspective 2.0.2 is better for 3-D modeling and animation. But DesignCAD's strengths are that it performs both functions reasonably well on moderate-size drawings and it sells for a relatively low price. If an inexpensive 2-D/3-D modeling tool is what you need, I'd definitely recommend DesignCAD. ■

Bill Calabrese is MIS/CADD director at Design Alliance, Inc. (San Luis Obispo, CA), an architectural design firm. You can reach him on BIX c/o "editors."

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(MicroCAD News review)

DesignCAD 2D



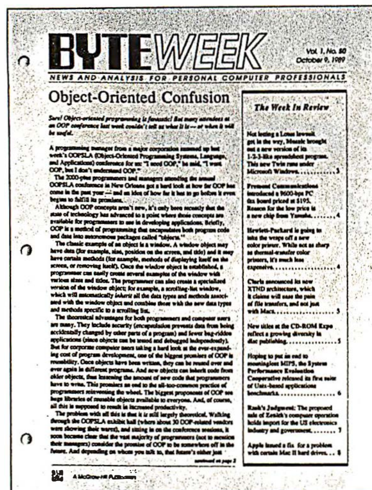
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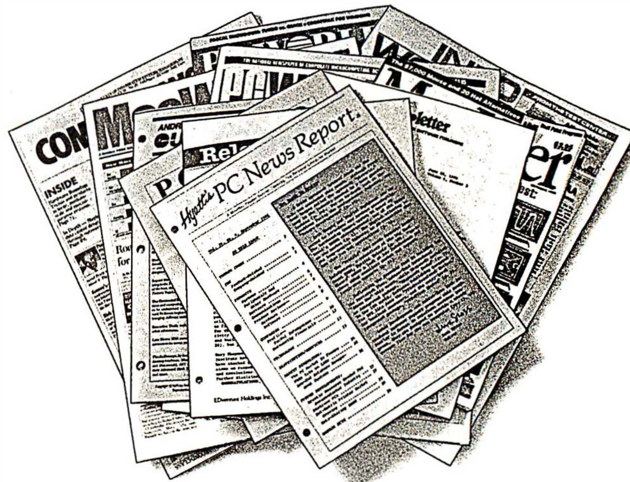


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HARDWARE

V-ATE Revs Up PC Diagnostics

STEVE APIKI



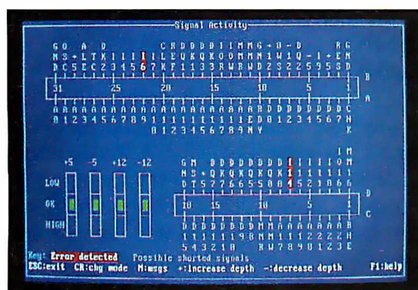
Vista's V-ATE add-in card for AT diagnostics. The distinctive metal shield and rugged bus connectors are designed for repeated installations and removal.

Some clones are fragile, temperamental things. Some can't keep track of the time or the date. Others have more elusive flaws, agreeing to run all but one of your applications without locking up solid. And almost every user has plugged a new adapter card into the bus, only to find that the sole response on throwing the power switch is the whir of the cooling fan.

What makes these troubles especially frustrating is the lack of diagnostic information. The most you can hope for is a series of beeps as your machine boots, and much of the time, the error is too subtle to be caught by the power-on self-test routines, or it is so severe that the machine never finishes the POST at all.

Vista Microsystems' V-ATE add-in card promises to give you the information you need to find and correct problems in shaky AT and 386 clones. It's more sophisticated than diagnostic boards such as Award Software's POST-card—the V-ATE has an on-board microprocessor and supports diagnosis by remote computer. However, it is less than a stand-alone logic analyzer in the versatility of the signals it monitors or uses as a trigger.

The card plugs into a 16-bit slot in the test system. You can use the V-ATE in one of two ways: with a second PC controlling the board or as a stand-alone device. When you use the remote diagnostic features, you can connect the second machine to the V-ATE with a standard serial connection. A second cable runs from a port on the V-ATE to the keyboard connector on the test system's motherboard.



V-CON's Activity screen flags errant signals and monitors bus power lines.

Running Solo

In stand-alone mode, the V-ATE runs a series of canned tests to discover failing motherboard components. When you start the test machine, it runs its POST routines as usual. The V-ATE shows which test is running on a pair of seven-segment LEDs. If the machine fails during the POST, the V-ATE displays the number of the test that failed.

If the system completes the POST, it passes control to the V-ATE ROM, which runs an extensive series of diagnostic tests. If you have a monitor connected, the system shows which tests are running and writes error codes with explanations to the screen; if not, it displays coded information on the LEDs. The manual provides a detailed explanation for each of its own tests and error codes, and it even provides a list of POST error codes for common BIOSes.

The V-ATE tests the system CPU, system RAM and extended RAM, system ROM, the real-time clock, system interrupts, DMA, bus-master capability, and the control, address, and data signals on the I/O bus. It also tests the keyboard port by running codes directly into the keyboard connector, and it tests the FPU if one is installed. The V-ATE recognizes when a test may be a false alarm; if IRQ6 or IRQ14 shows a connection, the V-ATE issues a warning but suggests that the error is probably due to a disk drive controller on the system bus.

Vista Microsystems sells the V-ATE in several configurations. I tested a Model 2000, which includes logic-analysis hardware that the base model doesn't have. If you intend to use the V-ATE as a stand-alone add-in for quality assurance or relatively simple diagnostics, you probably won't need more than the base model.

Remote Control

Controlling the V-ATE from a remote PC gives you access to some of its more powerful features. At power-up, the V-ATE checks to see if it is connected to a remote station. If it is, the V-ATE does not automatically run the test suite; instead, it sits and waits for instructions from the remote system.

Vista's V-CON software runs on the controlling PC. V-CON lets you run any of the 18 tests from the V-ATE ROM, or you can customize the suite by choosing the tests to include and the number of runs. Vista also provides hooks for writing your own test routines. The software commands the logic-analysis sections of the V-ATE 2000, letting you capture and analyze test-system data using a variety of tools.

V-CON has a menus-and-windows design, but I found the menu structure hard to navigate and the prompts and menu labels misleading. The V-ATE provides a lot of useful information, but V-CON in its default state makes that information hard to find. Fortunately, the menu is user-configurable.

If the machine you're testing is completely dead, you'll probably start out with V-CON's bus-activity monitor. The activity monitor watches signals on the bus for basic signs of proper operation (see the screen). It determines whether the power connectors on the bus are providing adequate voltage, if the clock signals are running, and if any of the control signals on the bus are stuck. The activity monitor displays a graphical representation of an AT backplane; bad signals are marked, and you can pop up a screen that describes the errors.

The V-ATE 2000 also scans the bus to find out if any of the bus signals are logically shorted. That is, if two channels match sample-for-sample for a significant portion of the captured data, V-CON warns that these signals may be shorted together.

The V-ATE 2000's logic-analysis module can come in handy when you have a system that locks up intermittently. It captures 2048 samples from the bus in V-ATE RAM. The analyzer monitors 72 channels; two of these can be from external probes.

The logic analyzer captures data in different ways, depending on what the test system is doing. During test-machine POST, the logic analyzer triggers at the start of each test. When the machine is running a V-ATE test, the analyzer triggers on events that are significant to the particular test; for example, the DMA test triggers at the start of each DMA transfer. Finally, you can trigger the analyzer directly from V-CON at any time.

The V-ATE also chooses a clocking mode automatically. (If you trigger the analyzer directly, you select the clocking mode.) On each clock, the analyzer reads in a new sample; the analyzer can clock on several bus signals or combination of signals. It can also clock on its own 15-MHz crystal.

V-CON can display analyzer data in three ways: as waveforms, as state information, or as disassembled instructions. The waveform display shows 20 signals at a time, and it looks and acts like a traditional logic-analyzer display. The software shows the status of the data and address lines at the cursor, and you can move the cursor from sample to sample.

The state display is essentially a listing of samples. It shows the state of key signals for each sample point. You can filter out uninteresting samples and move a highlight cursor from sample to sample.

Finally, you can view the data as disassembled instructions. Because the processor prefetches instructions, instruction and processor action do not always coincide, and watching all the bus activity at once can be confusing. Therefore, the disassembler can filter out noninstruction bus transactions to make things a little easier to read. One of the handier features of V-CON is that you can switch from waveform to state to disassembly mode with an Alt-key combination, and the highlight cursor will be on the same sample from display mode to display mode.

Test and Measurement

I installed the V-ATE 2000 in four systems. Two of them were working, one had intermittent failures, and the last was ready for the scrap heap. Only one of the working systems (an IBM AT) passed V-ATE scrutiny completely; the other failed a ROM test. The computer with intermittent problems showed real-time clock and I/O controller failures, and the dead system yielded lots of problems, including bad power lines. All in all, the results were impressive for the V-ATE, if disturbing for me—one of BYTE's working systems failed to pass muster.

A Vista representative explained that some of the errors flagged in working systems can be due to BIOS or motherboard idiosyncrasies. For example, the ROM failure was probably due to the system mapping some other device into the ROM address space.

All these machines were three- or four-year-old AT clones, the kind of machine you're likely to find on the repair-shop shelf today. But the Vista manual warns of some compatibility problems with features found on newer machines: 16-bit VGA cards, shadow and cache RAM, and RAM accesses that bypass the bus can all cause problems for the V-ATE.

The V-ATE without the logic analyzer is an excellent tool for locating the fault in a damaged system. If you repair PCs for a living, the V-ATE is definitely worth looking into.

The V-ATE is also a good choice for system assemblers looking for an inexpensive device for automated tests and quality assurance. Anyone who deals with a large number of PCs can benefit; the V-ATE's tests can help to identify unreliable designs or brands with spotty quality control.

With the logic-analyzer option, the V-ATE can help catch more subtle problems. For repair shops or customers with a large PC inventory, the analyzer option may be useful. However, the V-ATE is not quite powerful enough for hardware designers or software developers to consider using as a primary development tool. ■

Steve Apiki is a testing editor/engineer for the BYTE Lab. You can reach him on BIX as "apiki."

BYTE ACTION SUMMARY

- **V-ATE 2000**
- **WHAT YOU'LL GET**
  An 8051 microprocessor-based diagnostic device that can pinpoint existing and potential IBM AT-compatible motherboard faults. This board is recommended for system integrators, quantity buyers of PCs, and PC repair professionals.
- **WHAT YOU'LL LIKE**
  Although it lacks the versatility of a true logic analyzer, the V-ATE 2000 costs a fraction of the price.
- **WHAT YOU'LL DISLIKE**
  The V-ATE 2000 will not work with some advanced motherboard features: 16-bit VGA cards, shadow and cache RAM, and RAM accesses that bypass the bus.
- **SYSTEM REQUIREMENTS**
  Test system: IBM AT or compatible with functioning power supply
  Remote system: IBM PC or compatible with DOS 2.0 or higher, 512K bytes of RAM, one serial port, and a floppy or hard disk drive
- **WHAT YOU'LL PAY**
  $1495
- **FOR MORE INFORMATION**
  Vista Microsystems, Inc.
  6 Whipple St.
  North Attleboro, MA 02760
  (508) 695-8459
  fax: (508) 695-8688

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Talk Your Way Through Mac Applications



The Voice Navigator II's external box plugs into a Mac's SCSI port and can be terminated or not, depending on your system's configuration.

BYTE ACTION SUMMARY

- **VOICE NAVIGATOR II**
- **WHAT YOU'LL LIKE**
  Using simple voice commands that replace several mouse-clicks and keyboard entries.
- **WHAT YOU'LL DISLIKE**
  System confusion created by similar commands and stray sounds.
- **WHAT YOU'LL NEED**
  $795 for Navigator hardware and software; a Macintosh; and System 6.0 or higher.
- **FOR MORE INFORMATION**
  Articulate Systems, Inc.
  99 Erie St.
  Cambridge, MA 02139
  (617) 876-5236
  fax: (617) 661-3278

  Circle 980 on Inquiry Card.

Voice Navigator II adds to the stream of relatively low-cost products that let you control your Mac with voice commands (see "Voice Recognition for a Song," August 1990 BYTE). While it won't replace your mouse or keyboard, the Navigator can be a welcome partner to other input devices.

The Navigator consists of a microphone and a SCSI-based, book-size external box. You can terminate it or not, depending on your system's configuration. Unfortunately, the switch that toggles the device between terminated and nonterminated isn't labeled, so until you memorize which position is which, you will have to refer back to the manual.

The software includes an INIT that lets you control the voice options, and a desk accessory (DA) called Language Maker that lets you create a language file for any Mac application.

Each language file contains the hierarchical menu command structure for a particular application. Navigator voice files contain the recorded voice of (usually) a single user vocalizing the commands in a set of language files. To create a voice file, you just say each command three times.

I tested the product on a Mac SE and a Mac IIsi with 2.5 and 4 megabytes of memory, respectively. I tried it with MacDraw, MacPaint, Microsoft Word, Microsoft Excel, Cricket Presents, Rendezvous, and Quicken. Training the Navigator to respond to my voice was easy. The Language Maker DA created the language files almost automatically, and a dialog box walked me through the process of building the voice file.

After this initial training, however, the system required some tweaking. For one thing, I found that the system consistently confused commands such as Align Left and Align Right. Retraining some commands with different words solved the problem; for example, Align Left became Move Left. But that meant that I had to memorize a number of idiosyncratic commands. Also, after two weeks of using the system, I still hadn't trained it to ignore all extraneous office sounds. A new telephone ring or the rumbling of a delivery person's hand truck caused my Mac to perform an unwanted action or slowed it down while it tried to figure out the "command."

With Navigator, my productivity increases varied greatly from application to application. For example, in Microsoft Word, my fingers automatically flew to the function keys faster than I could vocalize the commands. Similarly, in Microsoft Excel, I manually keyed digits faster than I could vocalize each one (while also remembering to say *niner* for nine). I had better productivity gains in Excel when I programmed a set of single-phrase commands for actions that normally took several mouse-clicks and keyboard entries.

The biggest gains came with graphics programs that use the mouse both to draw and to select palette items. The ability to keep my mouse on the drawing screen while using Navigator to vocally select a tool or pattern was a big help.

While it has some limitations, Navigator adds a welcome third element to the Mac's command input methods. Function keys are faster, but they are difficult to memorize. It will increase your productivity most in quiet settings, in applications where you have not memorized function-key equivalents, and in graphics applications where the mouse has to do double and triple duty. ■

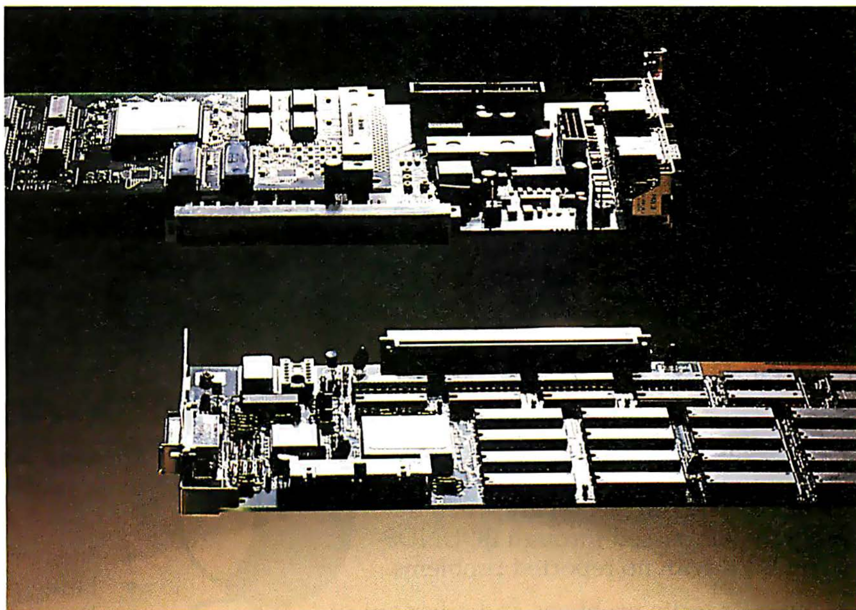
—**Larry Stevens**

More Full-Motion Video for the Mac

With its DVA-4000 NuBus boards, VideoLogic's approach to full-motion digital video has arrived for the Mac in true Macintosh style. (For a review of the PC version, see "Window Wonderland," June 1990 BYTE.) Within 10 minutes of unpacking the DVA-4000/Macintosh, you can view and capture live or prerecorded video for multimedia presentations.

The system off-loads video processing from the main CPU to deliver a smooth display with no performance degradation. Just snap the pair of boards into any Mac II. With the supplied cables and plug adapter, you connect the Mac and an Apple 13-inch RGB monitor to a videocassette recorder, camcorder, or laser disc player. (Additional adapters may be required depending on your video peripherals.)

You can view video in a 320- by 240-pixel window through the Control Panel or in a resizable window through the VideoSnap application, which captures frames in 8- and 24-bit color or gray scale (true, indexed, or dithered). Maintaining aspect ratio is optional, as is framing the video in black.



The DVA-4000/Macintosh easily displays full-motion video in scalable windows for multimedia presentations.

The interface of VideoSnap 1.0 is Mac-ishly aesthetic and functional. I had no trouble using the Multimedia Interactive Control System II software, which includes a tutorial, product tour, XCMD and XObject interfaces to HyperCard, MacroMind Director, Authorware, and HyperCard templates. With these tools and the MIC Toolbox command syntax, you can overlay video with titles and special effects such as wipes, washes, fades, animation, and sound. You can also export video frames in color PICT to SuperCard, MediaMaker, Film Maker, Studio 8, UltraPaint, PixelPaint Professional, and PhotoShop. You can edit, overlay, antialias, or animate the frames. For example, I opened one video frame in PixelPaint, edited it, and created a four-color separation.

The Control Panel resource allows full configuration of video brightness, contrast, saturation, sharpness, and hue; selection between NTSC and PAL TV standards, as well as composite, S-video, and RGB input modes; and audio adjustments. On-line help is available, as are cursor and selection coordinate readouts in the application's tool palette.

The boards off-load video processing from the CPU to deliver a smooth display with no performance degradation. The composite NTSC signal's RGB-encoded conversion was always crisp as I worked with nine videocassettes and two laser discs under MultiFinder—even during simultaneous database queries, large file conversions, print spooling, and fax modem transmissions that otherwise tax my nondedicated network server. Audio played in full stereo fidelity through my set of Bose Roommate speakers.

The DVA-4000 displays live TV when tied to an external tuner using an optional $100 cable. By the second quarter, VideoLogic plans to offer a $2000 external box option to output video to tape. Videodisk-player and tape controls are also planned for the future.

Although expensive, the DVA-4000 is a capable system that could pay for itself in saved studio fees for corporate and professional multimedia presentation producers.

—Steven M. Deyo

Reviewer's Notebook provides new information—including version updates, new test data, long-term usage reports, and reader feedback—on products previously reviewed in BYTE.

BYTE ACTION SUMMARY

- **DVA-4000/MACINTOSH**
- **WHO NEEDS IT**
  Macintosh-based presentation producers who use full-motion video.
- **SYSTEM REQUIREMENTS**
  Mac II with an Apple 13-inch RGB monitor or equivalent, 1 MB of RAM, a hard disk drive, a video input source, and an audio amplifier; System 6.0.3 or higher and 32-Bit QuickDraw
- **WHAT YOU'LL PAY**
  $2995
- **FOR MORE INFORMATION**
  VideoLogic, Inc.
  245 First St.
  Cambridge, MA 02142
  (617) 494-0530
  fax: (617) 494-0534
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Circle 207 on Inquiry Card.

ANDREW SCHULMAN

UNDOCUMENTED DOS



MS-DOS contains many hidden functions that are undocumented but that play a vital role in PC software development

On each of the 30 million or more PCs across the globe that run it, MS-DOS provides not only its familiar (and contemptible) user interface of the A> or C> prompt but also a programmer's interface. As users make DOS requests by typing commands, such as DIR *.EXE or SUBST F: C:\SWAP, or more often by typing the names of programs, such as "123", so programs themselves make DOS requests (to open a disk file, to allocate memory, or even to terminate) by moving a function number into the Intel processor's AH register and issuing the assembler instruction INT 21. For example, a program can open a file with INT 21 AH=3D, allocate memory with INT 21 AH=48, or exit with INT 21 AH=4C. The MS-DOS programmer's interface consists of several software interrupts; the most important is INT 21.

But open an official reference to the MS-DOS programmer's interface, such as IBM's *DOS Technical Reference* or Microsoft's *MS-DOS Encyclopedia*, and you will find that the INT 21 function numbers jump straight from 4F (Find Next) to 54 (Get Verify Setting), with nothing said about the numbers in between. Even Ray Duncan's *Advanced MS-DOS Programming*, still the best book on the topic, simply lists functions 50 through 53 as "Reserved."

If you found that there were useful functions here that you could safely use on any of the at least 30 million machines that run MS-DOS, would you use them?

Microsoft has a standard policy statement ("Regarding the Use of Undocumented MS-DOS Features," September 5, 1988) about programs that use undocumented DOS functions and data structures: "Microsoft does not give out any information about undocumented system features. If calls, flags, or interrupts are undocumented, it is because they are not supported; we can give NO guarantee that they will exist in future releases of DOS. If you find out about these features (through articles or by chance) and begin using them in your programs, there is a real potential that your application will not work in future DOS versions. We strongly advise against using undocumented features for these reasons and will give out no information about their use."

This is a reasonable statement, but there are other possible views on this subject. I argue that PC programmers should know about undocumented DOS functions and data structures. These features are necessary to fulfill MS-DOS's potential as an extensible operating system.

DOS: The Lost Sessions

So, what about the missing functions between 4F and 54? Since the official DOS documentation says nothing

about these function numbers, Microsoft does not support them. But there are important functions here, in all versions of DOS from 2.0 up, that are used in many commercial programs—including the DOS utilities PRINT, JOIN, and SUBST in Microsoft Windows, and the following in Desqview:

- INT 21 FUN 50 (Set PSP)
- INT 21 FUN 51 (Get PSP)
- INT 21 FUN 52 (Get List of Lists)
- INT 21 FUN 53 (Translate BIOS Parameter Block)

These are just some of many crucial holes in the documented programmer's interface to MS-DOS. Another hidden area of DOS is INT 21 FUN 5D, which consists of 12 subfunctions that handle an assortment of tasks, including DOS calls over a network (Server Function Call) and support for DOS reentrancy (Get Address of DOS Swappable Data Area).

Even some of the INT 21 functions that are documented have undocumented subfunctions (e.g., INT 21 FUN 4B SUB 01 loads a program without executing it and is crucial for writing a DOS debugger). They also have undocumented behavior or side effects (e.g., documented INT 21 FUN 56 exhibits interesting behavior when invoked indirectly via undocumented INT 21 FUN 5D SUB 00). The INT 21 functions even have (dare I say it?) outright bugs—for example, in the DOS Resize Memory Block function, INT 21 FUN 4A.

Besides INT 21, there are other DOS software interrupts, such as INT 2F, which contains entire undocumented subsystems (e.g., the network redirector INT 2F FUN 11) and a mechanism for adding new internal commands to the DOS command interpreter (INT 2F FUN AE).

Actually, these missing functions are merely the most apparent portion of undocumented DOS. The real core of undocumented DOS is its data structures. There are undocumented fields in the Program Segment Prefix (PSP) and the Memory Control Block (MCB), as well as structures whose existence is undocumented, such as the Drive Parameter Block (DPB). And there are the undocumented DOS internal variable table (List of Lists), the System File Table (SFT), and the Swappable Data Area (SDA).

Not Just Permission, But Support

Thus, while MS-DOS really is a small piece of code (which accounts in large part for its tremendous effectiveness), it is nonetheless far from being a self-enclosed, static world. This small piece of code contains many uncharted areas.

DOS functions that are not documented fulfill MS-DOS's potential as an extensible operating system.

The reason you should even care about undocumented DOS is that many of the DOS functions and data structures that Microsoft has not documented are crucial to truly fulfill MS-DOS's potential as an extensible operating system. Even though DOS permits almost infinite extensibility, support for DOS extensions (as opposed to mere permission) tends to reside in the undocumented areas of the DOS programmer's interface.

The field of memory-resident software is a good example. MS-DOS allows programs to install interrupt handlers and to be TSRs. The three documented INT 21 functions 25 (Set Interrupt Vector), 31 (TSR), and 35 (Get Interrupt Vector) are sufficient to hook into, modify, or replace even INT 21 itself. This is an extremely powerful capability. Nothing in DOS prevents you from extending it in whatever way you see fit.

But nothing particularly supports you in that endeavor, either, and that's the problem. The functions that actually help the application behave properly once it is resident are notoriously undocumented. The DOS functions most critical to consistent TSR operation are as follows:

- INT 21 FUN 34 (Return InDOS Pointer)
- INT 21 FUN 50 (Set PSP)
- INT 21 FUN 51 (Get PSP)
- INT 21 FUN 5D SUB 06 and INT 21 FUN 5D SUB 0B (Get DOS SDA)
- INT 21 FUN 5D SUB 0A (Set Extended-Error Information)
- INT 28 (Keyboard Busy Loop)

To this day, Microsoft has not added these to the official MS-DOS programmer's interface. In DOS 3.0 or higher, INT 21 FUN 51 is no longer strictly necessary, because the equivalent INT 21 FUN 62 (Get PSP Address) was added. But the other functions remain unsupported.

By now, information on undocumented DOS TSR support is widely available, and it is well known that, to write correct and stable TSR programs, you must use undocumented functions. While Microsoft refuses to guarantee that this information will be valid for future versions of DOS, its own publications, such as the *MS-DOS Encyclopedia*, have no choice but to openly discuss some of these unsupported functions; you can't write correct TSRs without them. Far from producing unreliable software, undocumented functions can be necessary to produce reliable software in the somewhat twisted land of DOS.

Another example is the DOS file system. Anyone who has used a PC on a network knows how disk drives on another machine, perhaps not even a PC running DOS, can be made to appear to be a local disk drive. You might type DIR E:, for instance, to see the filenames (possibly truncated to fit DOS's 8.3 pathetic filename format) on a Macintosh. How does that work? How are all the INT 21 calls that are necessary to produce a directory listing sent over the network to another machine, and how can you write such software yourself?

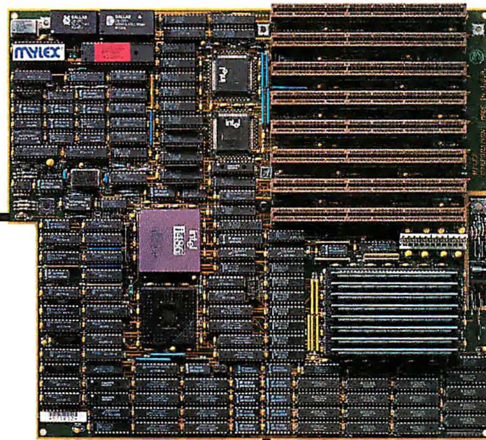
The fact that this is not just a network issue is shown by the Microsoft CD-ROM extension, a fascinating piece of software that uses undocumented DOS

THE PROGRAM SEGMENT PREFIX

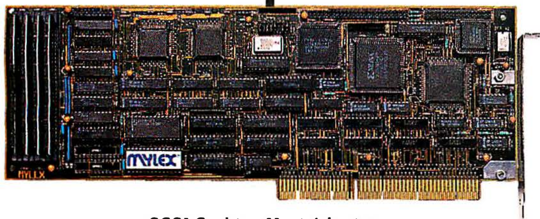
Some undocumented fields in the PSP.

Offset	Size	Purpose
16h	WORD	PSP address of program's parent
18h	20 bytes	Program's default Job File Table
32h	WORD	Maximum number of open files (size of JFT)
34h	FAR PTR	Address of program's actual JFT

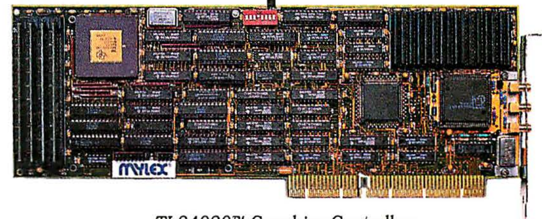
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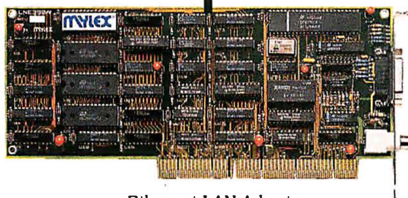
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file-system features to make a CD-ROM look like a normal DOS device. Obviously, there must be some features in DOS that let you write fiction, as it were: taking a CD-ROM with the High Sierra or ISO-9660 file system and making it look as though it were a standard DOS device with a file-allocation-table system. MSCDEX designates the drive letters it assigns to CD-ROM device drivers not as local drives but as remote network drives, even though the CD-ROM player is probably sitting on the desk next to the computer and not connected to it via a network. MSCDEX uses a component of MS-DOS called the *network redirector*. Microsoft has never documented the network redirector, but networks and installable file systems use the network redirector in part by writing an interrupt handler for INT 2F FUN 11. Whenever DOS receives an application request for a file located on such a remote drive, it calls your INT 2F FUN 11 handler and lets you decide how to service the request.

In this case, at first it is less clear that undocumented DOS is absolutely necessary. After all, Novell has been producing reliable high-performance networks for MS-DOS since long before Microsoft added the network redirector. Rather than hook INT 2F FUN 11, Novell hooks INT 21 itself, looking for file and printer-related requests. But while avoiding use of the undocumented network redirector, NetWare simply uses other undocumented features of DOS.

One last example: To write a DOS debugger such as Debug, SymDeb, CodeView, or Turbo Debugger, you need a function that loads a program without executing it. DOS provides this as subfunction 01 to INT 21 FUN 4B (EXEC), and it is used in all three generations of the Microsoft debugger. Unfortunately, the official MS-DOS technical references simply list INT 21 FUN 4B SUB 00 and INT 21 FUN 4B SUB 03; you find that INT 21 FUN 4B SUB 01 is undocumented.

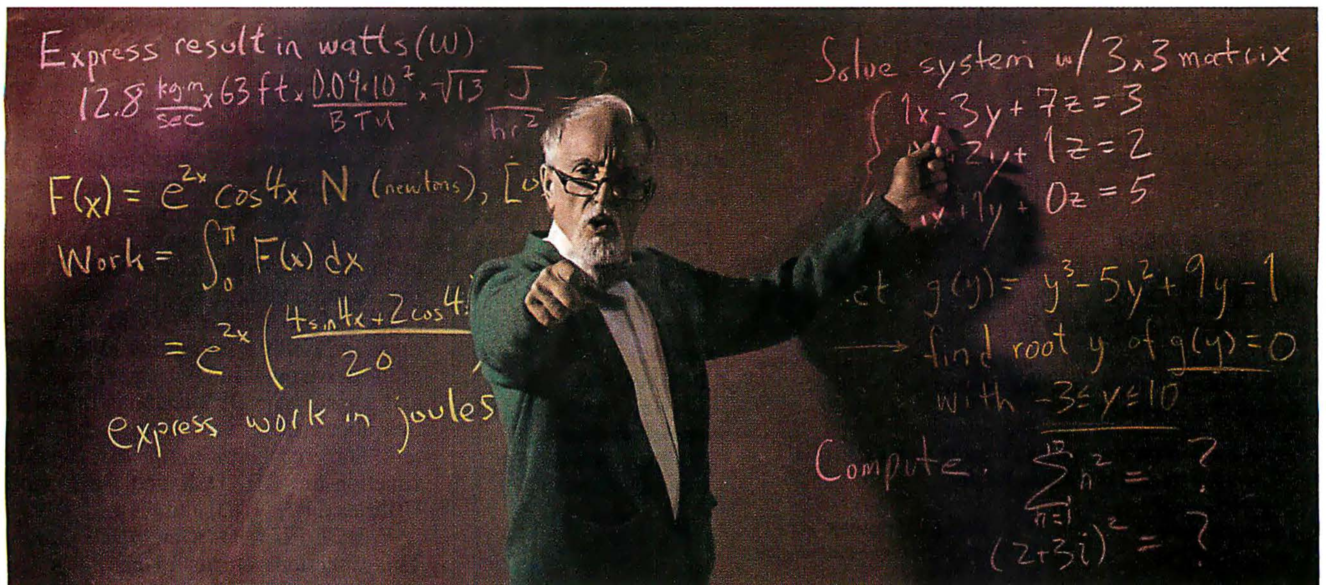
Highlights of Undocumented DOS

I'll attempt to summarize some of the key features that undocumented DOS provides. While I'm not discussing DOS version numbers in depth here, note that practically all these functions are provided in all versions of DOS from 3.0 on, including the forthcoming DOS 5.0.

Undocumented fields in the PSP. Every DOS program has a PSP, and IBM and Microsoft document the PSP's basic structure. But many crucial fields in the PSP are not documented (see the table).

continued

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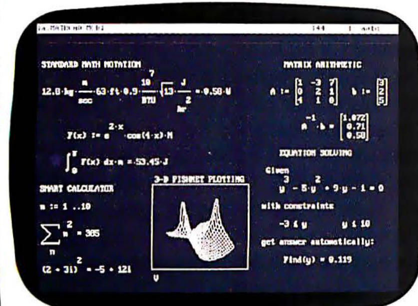
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Because each PSP contains (at offset 2C) the paragraph address of the program's environment, a program can use the undocumented parent PSP pointer at offset 16 hexadecimal to access its parent's environment.

A program's open-file handles are merely indexes into the Job File Table. Each JFT entry is, in turn, an index into the SFT. There are many things you can do once you know where to find the table of all open files. For example, sometimes you need to know the filename and have only its handle available; you could write a function `h2name( )` that, given an open-file handle, returns the name of the corresponding file.

INT 21 FUN 32 (Get DPB). This returns in DS:BX a far pointer to the DPB of the drive input in DL (e.g., 0=default and 1=A). The DPB contains information about the drive's sectors and clusters. Some of the programs that use this function are CHKDSK and the Norton Utilities (NU, NDD, and SD).

INT 21 FUN 34 (Get InDOS Flag). This function returns in ES:BX a far pointer to a 1-byte semaphore that controls access to DOS. Almost all TSRs, such as PRINT and SideKick, call this function to get the address of the semaphore, which they later monitor to know if it is safe to make INT 21 calls when the TSR pops up. Many non-TSRs also call this function, including Windows 3.0 and Desqview.

INT 21 FUN 37 SUB 01 (Set SWITCHAR). This can be used to change the default command-line switch character from / to – and the default path separator from \ to /. To make DOS input look slightly more Unix-like (e.g., `dir -w /foo/bar` rather than `dir /w \\foo\\bar`), programs providing Unix utilities, such as the MKS Toolkit, generally provide a small program that merely calls this function; presumably, this eases the transition into MS-DOS for Unix-bred graduate students.

INT 21 FUN 4B SUB 01 (Load But Don't Execute). This is similar to documented INT 21 FUN 4B SUB 00 (EXEC), but it returns control to the caller without executing the child program. The child program is ready for execution, however, making INT 21 FUN 4B SUB 01 perfect for debuggers. As I mentioned earlier, all three Microsoft debuggers (Debug, Symdeb, and CodeView), plus programs such as Turbo Debugger, use this undocumented subfunction.

INT 21 FUN 50 (Set PSP). At any given moment, DOS has a current PSP. By changing the current PSP and other similar values, such as the current Disk

Transfer Area (DTA), DOS can effectively multitask between different programs. A program changes DOS's current PSP, effectively setting the new foreground program, by calling INT 21 FUN 50 with the new PSP in BX. INT 21 FUN 50 is used by almost all TSRs and by multitaskers, such as Windows and Desqview; debuggers; and protected-mode DOS extenders, such as 386|DOS-Extender (to switch between a protected-mode program like AutoCAD/386 and the DOS extender itself).

INT 21 FUN 51 (Get PSP). This is used in conjunction with INT 21 FUN 50. DOS's current PSP is returned in BX. In DOS 3.0 or higher, you can use documented INT 21 FUN 62 instead. Note that both INT 21 FUN 51 and INT 21 FUN 62 do not necessarily return the PSP of the program that called them: They return whatever is in the current PSP field of the DOS SDA.

INT 21 FUN 52 (Get List of Lists). This function returns in ES:BX the address of the DOS internal variable table, sometimes given the biblical-sounding name List of Lists. This undocumented structure in turn contains pointers to many other undocumented DOS structures, including the MCB chain, device driver chain, the Current Directory Structure, and SFTs. This is probably the most important undocumented DOS function: Programs can use the information extracted from the List of Lists to walk the DOS memory chain and, by extension, through the PSP chain, walk the CDS, SFT, and so on. For example, using this function, a coauthor of the book *Undocumented DOS* wrote a program that loads device drivers from the DOS command line. Among the many programs that call this undocumented function are the DOS utilities SUBST and JOIN (which poke the CDS) and Quarterdeck's diagnostic program Manifest.

By changing the current PSP, DOS can multitask between programs.

INT 21 FUN 53 (Translate BIOS Parameter Block). Given a pointer to a BPB, this returns an equivalent DPB (see INT 21 FUN 32, above).

INT 21 FUN 55 (Create New PSP). This is similar to documented INT 21 FUN 26, but rather than simply copy the current PSP, it creates a proper *child* PSP. Desqview and Phar Lap's 386|DOS-Extender use this function.

INT 21 FUN 5D SUB 00 (Server Function Call). Part of DOS's built-in support for networking, this function indirectly executes an INT 21 call using a specified computer ID and process ID (PSP). Because a computer ID of zero indicates the current system, you can also use this call in nonnetwork situations. For example, the handle-based file rename and delete functions can be used with wild cards when invoked indirectly via INT 21 FUN 5D SUB 00.

INT 21 FUN 5D SUB 06 (Get DOS SDA). This returns in DS:SI a far pointer to the DOS SDA. It's effectively the address of the DOS data segment. Because the SDA includes such crucial values as the current PSP, current DTA, and the three DOS stacks, you can use this function as part of a scheme for making DOS reentrant. The value returned in CX is the number of bytes (generally less than 2K) to swap when the InDOS semaphore is set; DX holds the number of bytes that must always be swapped. After swapping SDAs, a program such as a TSR or a multitasker can freely make INT 21 calls, regardless of the state of the InDOS flag (however, the program should watch for network critical sections, using INT 2A FUN 80 through INT 2A FUN 87). This function is called by Windows 3.0 and by TSRs created with the popular CodeRunneR toolkit. DOS 4.0 and up can have multiple SDAs; INT 21 FUN 5D SUB 0B returns the list of SDAs.

INT 21 FUN 5D SUB 0A (Set Extended-Error Information). This is used in conjunction with documented INT 21 FUN 59 (Get Extended-Error Information). When a TSR pops up, it should save and restore the DOS extended-error information so that possible INT 21 errors belonging to the pop-up program don't corrupt the extended-error information belonging to the interrupted foreground process. Microsoft's *MS-DOS Encyclopedia* (p. 352) recommends using the function for correct TSR operation but doesn't support it.

INT 21 FUN 60 (Canonicalize Path String). This function returns the *canon-*

Listing 1: *The FILES program running in a Windows 3.0 DOS box.*

```
C:\WIN30>files > files.log
C:\WIN30>type files.log
Filename        Size     Attr    Handles     Owner
--------        ----     ----    -------     -----
AUX     .          0     0000      14        9DA8 [NOT PSP]
CON     .          0     0000      44        9DA8 [NOT PSP]
PRN     .          0     0000      14        9DA8 [NOT PSP]
WIN386  .SWP  999424     0020       1        4138
USER    .EXE  231680     0020       1        421A
COURE   .FON   21360     0020       1        421A
HELVE   .FON   59696     0020       1        421A
PROGMAN .EXE   55200     0020       1        421A
PROGMAN .EXE   55200     0020       1        421A
VGAOEM  .FON    5584     0020       1        421A
EGA80WOA.FON    5680     0020       1        421A
EGA40WOA.FON    8736     0020       1        421A
CGA80WOA.FON    4672     0020       1        421A
CGA40WOA.FON    6704     0020       1        421A
PIFEDIT .EXE   40124     0020       1        421A
VGAFIX  .FON    5776     0020       1        421A
WINOA386.MOD   29520     0020       1        421A
COMM    .DRV    7088     0020       1        421A
GDI     .EXE  129691     0020       1        421A
FILES   .LOG     524     0020       2        421A
```

Listing 2: *FILES reveals orphaned file handles.*

```
C:\UNDOC> sk > nul
C:\UNDOC> files > tmp.tmp
C:\UNDOC> type tmp.tmp
Filename      Size    Attr    Handles     Owner
--------      ----    ----    -------     -----
AUX .          0      0000       8        9DED [NOT PSP]
CON .          0      0000      22        9DED [NOT PSP]
PRN .          0      0000       8        9DED [NOT PSP]
NUL .          0      0000       1        0AE9 [ORPHAN]
TMP .TMP       0      0020       2        0AE9
```

Listing 3: *You can use FILES.C to create FILES.EXE and FREEUP.EXE.*

```
/*
FILES.C -- list all files in system file table
        -- can free up orphaned file handles

Microsoft C 6.0 (uses inline assembler):
    cl files.c
    cl -DFREEUP -Fefreeup.exe files.c

Turbo C:
    tcc files.c
    tcc -DFREEUP -efreeup.exe files.c
*/

#include <stdlib.h>
#include <stdio.h>
#include <dos.h>

typedef unsigned char BYTE;
typedef unsigned USHORT;
typedef unsigned long ULONG;
typedef BYTE far *FP;

#pragma pack(1)

typedef struct file {
    USHORT num_handles, open_mode;
    BYTE fattr;
    USHORT dev_info; // includes drive number
    FP ptr;
    USHORT start_cluster, time, date;
    ULONG fsize, offset;
    USHORT rel_cluster, abs_cluster, dir_sector;
    BYTE dir_entry;
    BYTE filename[11];
    ULONG share_prev_sft;
    USHORT share_net_machine;
    USHORT owner_psp;
    // ...
    } file; // for DOS 3.x, 4.x

typedef struct sysftab {
    struct sysftab far *next;
    USHORT num_files;
    file f[1];
    } SYS_FTAB;

typedef struct {
    BYTE type;
    USHORT owner; /* PSP of the owner */
    USHORT size;
    BYTE unused[3];
    BYTE dos4[8];
    } MCB;

void fail(char *s) { puts(s); exit(1); }

#ifdef _TURBOC_
#define GETVECT(intno) getvect(intno)
#define ASM            asm
#else
#define GETVECT(intno) _dos_getvect(intno)
#define ASM            _asm
#endif

#ifndef MK_FP
#define MK_FP(seg,ofs) ((FP)(((ULONG)(seg) << 16) | (ofs)))
#endif

/*
    MCB chain isn't a linked list (all blocks are contiguous),
    but make it look as though it were
*/
#define NEXT(mcb) (MK_FP(FP_SEG(mcb) + (mcb)->size + 1, 0))

/*
    Does address "vec" fall inside segment beginning at "start"
    and continuing for "size" paragraphs?
*/
int belongs(FP vec, USHORT start, USHORT size)
{
    USHORT seg = FP_SEG(vec) + (FP_OFF(vec) >> 4);
    return (seg >= start) && (seg <= (start + size));
}

/*
    Is seg really a PSP?
    Yes, if there's an MCB at seg-1 whose owner is this seg,
    and if the first two bytes in seg are an INT 20h (CDh 20h)
    instruction
*/
int is_psp(USHORT seg)
{
    return (((MCB far *) MK_FP(seg-1,0))->owner == seg) &&
           (*((USHORT far *) MK_FP(seg,0)) == 0x20CD));
}

/*
    Look for "orphaned" file handles: e.g., TSR>FOO.BAR or
    TSR>NUL will leave FOO.BAR or NUL entry in SFT,
    consuming file handle. If the PSP of the file's owner is
    COMMAND.COM and if there's only one owner, then we decide
    it's an orphaned handle.
*/
int orphan(file far *ff)
{
    static command_com_psp = 0;
    if (! ff->num_handles)
        return 0;
    if (! command_com_psp) /* do just one time */
    {
        FP int2e = (FP) GETVECT(0x2E);
        MCB far *mcb;
        ASM mov ah, 52h
        ASM int 21
        ASM mov ax, es:[bx-2]
        ASM mov word ptr mcb+2, ax
        ASM mov word ptr mcb, 0
        /* Walk MCB chain, trying to find COMMAND.COM PSP */
        while (mcb->type != 'Z')
            if (belongs(int2e, FP_SEG(mcb), mcb->size))
            {
                command_com_psp = mcb->owner;
                break;
            }
            else
                mcb = (MCB far *) NEXT(mcb);
    }
    return ((ff->owner_psp == command_com_psp) &&
            (ff->num_handles == 1));
}
```

ical or true form of a filename, with any SUBST, JOIN, ASSIGN, or network drive references resolved. Programs such as CHKDSK and the Norton Utilities (NDD and SD) call this function to make sure the user isn't trying to perform low-level disk operations on an entity that really isn't a disk (e.g., SUBST E: C:\UNDOC followed by CHKDSK E:. Here, the canonical form of E:. is C:\UNDOC, which is a subdirectory, not a disk).

INT 28 (Keyboard Busy Loop). There is one problem with the InDOS semaphore that is returned by INT 21 FUN 34 (see above). When the user is sitting at the C> prompt, COMMAND.COM is sitting inside the DOS Buffered Keyboard Input function (documented INT 21 FUN 0A). This means that while waiting for the user to enter a command, the InDOS flag is set. Normally, this, in turn, means that most TSRs would not be able to make INT 21 calls while DOS is effectively idling. As a workaround for its own PRINT spooler, Microsoft added the INT 28 interface. Programs that are idling can periodically invoke INT 28; TSRs can hook INT 28 to get permission to make INT 21 calls, even though the InDOS flag is set. Practically every commercial TSR hooks INT 28; some of them even remember to call it periodically.

INT 2E (Execute Command). This strange DOS interrupt takes the command string in DS:SI and passes it to the resident portion of COMMAND.COM;

```
#define IS_AUX(s) ((s[0]=='A') && (s[1]=='U') && (s[2]=='X'))
#define IS_CON(s) ((s[0]=='C') && (s[1]=='O') && (s[2]=='N'))
#define IS_PRN(s) ((s[0]=='P') && (s[1]=='R') && (s[2]=='N'))

main(void)
{
    SYS_FTAB far *sys_filetab;
    file far *ff;
    int size;
    int i;

    ASM mov ah, 52h
    ASM int 21
    ASM les bx, dword ptr es:[bx+4] /* ptr to first SFT */
    ASM mov word ptr sys_filetab, bx
    ASM mov word ptr sys_filetab+2, es

    /* DOS box of OS/2 1.x doesn't provide SFT */
    if (sys_filetab == (SYS_FTAB far *) -1L)
        fail("system file table not supported");

    switch (_osmajor)
    {
        case 2:  size = 0x28; break;
        case 3:  size = 0x35; break;
        default: size = 0x3b; break;
    }

      /* Perform sanity check: Determine size of file structure
         empirically from difference between strings "CON" and
         "AUX." If this equals size computed via _osmajor,
         everything is fine. Otherwise, we reset size. */
    {
       FP p, q;
       int i;
       /* i=1000: Set upper limit on string search in memory */
       for (p=(FP)sys_filetab->f, i=1000; i--, p++; )
           if (IS_AUX(p))
               break;
       if (! i) return 1;
       for (q=p, i=1000; i--, q++; )
           if (IS_CON(q))
               break;
       if (! i) return 1;
       /* size of file structure must equal span from AUX to CON */
       if (size != (q - p))
       {
           puts("size based on _osmajor looks wrong");
           size = q - p;
       }
    }

    printf("Filename      Size    Attr    Handles     Owner\n");
    printf("--------      ----    ----    -------     -----\n");

     do { /* FOR EACH SFT */

         /* FOR EACH ENTRY IN THIS SFT */
         for (i=sys_filetab->num_files, ff=sys_filetab->f;
              i--;
              ((FP) ff) += size)
         if (ff->num_handles)
         {
             if (_osmajor == 2)
             {
                 // didn't bother with struct for DOS2
                 FP ff2 = (FP) ff;
                 printf("%.8Fs.",   ff2 + 0x04);
                 printf("%.3Fs\t",  ff2 + 0x0c);
                 printf("%10lu\t",  *((ULONG far *) (ff2 + 0x13)));
                 printf("%04X\t",   ff2[0x02]);
             }
             else
             {
                 printf("%.8Fs.",   ff->filename);
                 printf("%.3Fs\t",  ff->filename + 8);
                 printf("%10lu\t",  ff->fsize);
                 printf("%04X\t",   ff->fattr);
                 printf("%d\t",     ff->num_handles);
                 printf("%04X\t",   ff->owner_psp);
                 if (! is_psp(ff->owner_psp))
                     printf("[NOT PSP]");
                 if (orphan(ff))
                     printf("[ORPHAN]");
             }
#ifdef FREEUP
              // only DOS 3+
              if (! IS_AUX(ff->filename))
              if (! IS_CON(ff->filename))
              if (! IS_PRN(ff->filename))
              if (orphan(ff) || (! is_psp(ff->owner_psp)))
              {
                  if (! (-- ff->num_handles)) // decrement owners
                      printf(" [FREED]");
                  else
                      printf(" [NOW %d]", ff->num_handles);
              }
#endif
              printf("\n");
          }
          /* FOLLOWED LINKED LIST... */
          sys_filetab = sys_filetab->next;
     } while (FP_SEG(sys_filetab) &&
              FP_OFF(sys_filetab) != (unsigned) -1);
              /* ... UNTIL END */
     return 0;
}
```

all registers are destroyed in the process. Under the right circumstances, you can use INT 2E to write a TSR pop-up command interpreter or to execute commands from within an application without reloading COMMAND.COM from disk. SET commands, invoked via INT 2E, set the master copy of the environment.

INT 2F FUN 11 (Network Redirector). This large set of subfunctions defines an interface that is known as the network redirector, described earlier. Rather than call INT 2F FUN 11, a program desiring to create a new DOS file system hooks INT 2F FUN 11 instead, servicing requests from DOS. Essentially, the network redirector can be used to create new DOS logical drives, even if it is not networked. This undocumented function is used not only by network software, like PC LAN and FTP Software's DOS implementation of TCP/IP, but also by nonnetwork software, such as MSCDEX.

INT 2F FUN AE (Installable Command). By hooking 2FAE00 and 2FAE01, a program (generally a TSR) can install new internal commands to COMMAND.COM (i.e., commands like CLS that don't load a program from disk). COMMAND.COM will call the program any time it receives a command it doesn't otherwise know about. This can also be used to add a help system to the exiting COMMAND.COM repertoire. Interestingly, such new internal commands are also then accessible via undocumented INT 2E.

continued

Listing 4: *Freeing an orphaned file handle.*

```
C:\UNDOC> freeup > freeup.log
C:\UNDOC> type freeup.log
Filename      Size    Attr     Handles     Owner
--------      ----    ----     -------     -----
AUX    .      0       0000     6           9DED [NOT PSP]
CON    .      0       0000     16          9DED [NOT PSP]
PRN    .      0       0000     6           9DED [NOT PSP]
NUL    .      0       0000     1           0AE9 [ORPHAN] [FREED]
FREEUP .LOG   0       0020     2           0AE9

:\UNDOC>files
Filename      Size    Attr      Handles    Owner
--------      ----    ----      -------    ----
AUX .         0       0000       6         9DED [NOT PSP]
CON .         0       0000       16        9DED [NOT PSP]
PRN .         0       0000       6         9DED [NOT PSP]
```

Manipulating the SFT

To show how to use some of these undocumented functions, I decided to write a utility called FILES that displays information about all open files in the system. For example, listing 1 shows the output from FILES when running in a DOS box in Windows 3.0.

Normally, there aren't this many open files. Often you have to redirect the output of FILES to a file (e.g., `files > files.log`) to see anything other than AUX, CON, and PRN. When its output is redirected, FILES inherits an open file from COMMAND.COM: This shows up in the last line of listing 1 as FILES.LOG with two owners.

FILES walks the DOS SFTs, descending into each one. It starts with the first SFT, pointed to by the DOS List of Lists, a pointer to which is in turn returned from undocumented INT 21 FUN 52, displays any files in that table, and then goes into a loop following the *next* field in each SFT, until it finds a next field whose segment is 0 or whose offset is −1 (FFFF). Within each SFT, an open-file entry contains the filename, its size, attributes, a reference count, and the PSP of the program that first opened the file. This information is displayed by FILES.

Under DOS 3.0 or higher, the FILES program puts much effort into finding file oddities, such as files whose owner is not a legitimate PSP, and files that have been *orphaned*, as shown in listing 2.

The first three entries—AUX, CON, and PRN—are always present in the first SFT. FILES prints out [NOT PSP] after the owner ID 9DED, because it found that this was not a legitimate PSP. Instead, the value is apparently the effective PSP at the time that the SYSINIT initialization code in IBMBIO.COM (PC-DOS) or IO.SYS (MS-DOS) opens AUX, CON, and PRN (SYSINIT relocates itself to the top of memory, accounting for the high address).

The next entry displayed in listing 2, NUL, is marked as an [ORPHAN]. An orphaned file handle is generally the result of redirecting the output from a memory-resident utility to a file, as I did here with SideKick. TSR>NUL leaves behind an open SFT entry for NUL, because DOS can't close a process's files when it terminates via the TSR call (INT 21 FUN 31). Such orphaned file handles can cause mysterious system crashes, because, with enough orphans clogging up the SFTs, there can be no free entries left to open files, and many programs blithely assume that all their file opens are successful.

In the example above, FILES decided that NUL was an orphan because its owner was COMMAND.COM, yet it had only one owner. The program gets the PSP for COMMAND.COM and compares this with the owner PSP. If a file's owner is COMMAND.COM, it might be an orphan. In this example, TMP.TMP (to which I redirected the output of FILES) was *not* an orphan. But NUL has only one owner, and that owner is COMMAND.COM. This is a sure tip-off that the other party in the redirection hasn't exited. Since the TSR has no possible use for this NUL handle (which it doesn't even know about), it is safe to close this handle by decrementing its reference count in the SFT. Code to do so is handled in FILES.C by `#ifdef FREEUP` (see listing 3).

A considerable amount of the source code in FILES.C is devoted to issues surrounding the DOS version number. In addition to checking for an SFT pointer of FFFF:FFFF, probably returned from the DOS box in OS/2 1.x, the program also performs a sanity check to see if the size of the DOS file structure really matches the size that I've determined from the DOS version number.

If FILES.C is recompiled to enable the free-orphan code, you can create FREEUP.EXE in addition to FILES.EXE. Assuming that an orphaned NUL handle is still lurking around the SFT, running FREEUP produces the results shown in listing 4. Notice that FREEUP doesn't do anything stupid like free up the file for its redirected output, and that AUX, CON, and PRN don't get changed, even though they have invalid owner PSPs and are therefore otherwise perfect candidates for being freed up.

FREEUP can be useful in AUTOEXEC.BAT files where you want to discard the TSR's initialization output without losing file handles:

```
tsr > nul
freeup > nul
```

Who Is at Risk?

There is already a large collection of popular PC applications that use undocumented DOS. Are the vendors of all these programs going to get burned with the next version of DOS?

It's instructive to read what Gordon Letwin, Microsoft's chief architect for system software, says about this in his book *Inside OS/2*: "It may seem that if a popular application 'pokes' the operating system and otherwise engages in unsavory practices that the authors or users of the application will suffer because a future release, such as OS/2, may not run the application correctly. To the contrary, the market dynamics state that the application has now set a standard, and it's the operating system developers who suffer because they must support that standard."

In other words, when popular applications use undocumented DOS, it's ultimately Microsoft that is inconvenienced, not the application's developer. Meanwhile, smaller developers can ride the coattails of the larger developer's use of undocumented DOS. If enough important applications use it, yesterday's undocumented hack becomes tomorrow's de facto standard. The market has spoken. Amen. ■

Editor's note: *This article was adapted from the book* Undocumented DOS: A Programmer's Guide to Reserved MS-DOS Functions and Data Structures, *edited by Andrew Schulman (Reading MA: Addison-Wesley, 1990).*

Andrew Schulman is a software engineer and writer at Phar Lap Software. He edited the book Undocumented DOS *and contributed to the recent* Extending DOS *(edited by Ray Duncan). He can be reached on BIX c/o "editors."*

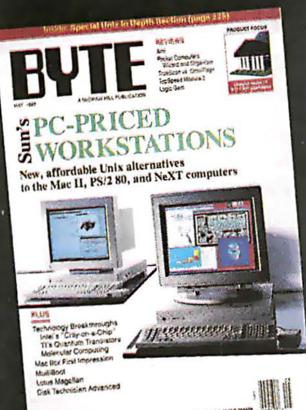
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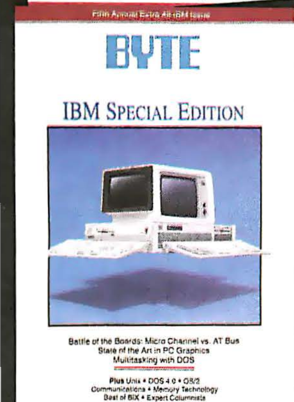
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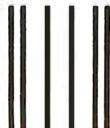
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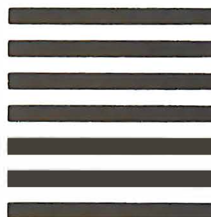
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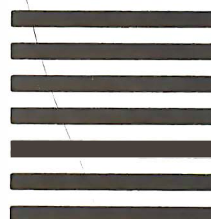
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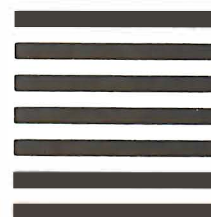
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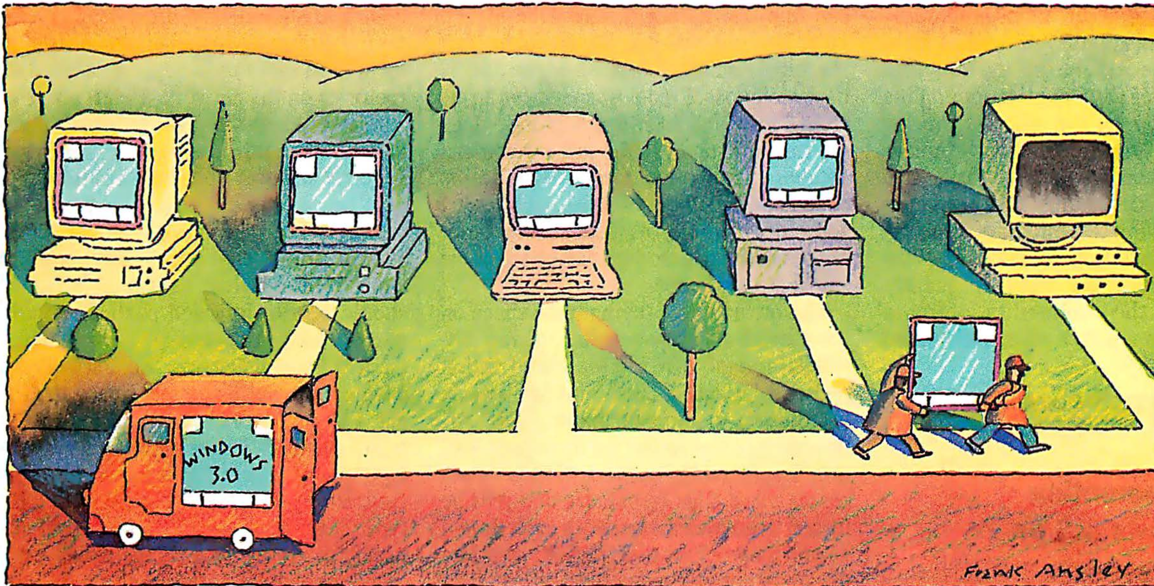
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NETWORKING WINDOWS



Making Windows 3.0 work on a network takes planning, but the up-front work will save time and effort in the long run

Microsoft's Windows 3.0 has made short work of capturing the PC desktop. With increasing frequency, people are beginning to ask about networked environments. In many ways, the marriage of Windows and networks makes sense. Why would you want 100 separate workstations, each running local versions of Windows, if you can have just a few copies on file servers?

But putting Windows on the file server poses some setup and configuration challenges, just as it does on stand-alone PCs. Last month, we examined some of the problems that people have encountered when installing Windows in stand-alone mode (see "Making Windows Work," February BYTE). Here, we provide pointers for those of you implementing Windows on a network.

Why on a Network?

When you install Windows in stand-alone mode on a PC, *all* Windows software, including initialization and customization files and dynamic link libraries (DLLs), are on your local hard disk (see the figure). Thus, Windows is stored in its entirety on your own machine.

In a networked environment, the Windows DLLs (i.e., executable files) can be stored permanently in a shared directory on a file server, while each user's initialization and customization files are kept on his or her local hard disk drive. Windows doesn't actually run on the server, but some of its key files can be stored there. These executable files are transferred into local RAM at load time.

For diskless PCs, DLLs are kept in the shared directory, and initialization and customization files are stored in the user's private directory on the file server. The SETUP program is smart enough to recognize which configuration you have and takes the appropriate installation actions.

There are several advantages to running Windows from a file server. The most important are access and management of network resources through the Windows interface. You can connect and disconnect remote printers with the Control Panel, view and manage remote files with the File Manager, and view or change the status of print jobs on remote printers with the Print Manager.

Installing Windows DLLs on a file server also means that local PC storage requirements are somewhat reduced. On networks with large numbers of nodes, these savings can add up to dozens or hundreds of megabytes. This is especially important for concentrations of PCs with small-capacity hard disk drives.

Planning

Before you consider running Windows 3.0 on a LAN, take a close look at the software applications, users,

and hardware configurations that make up your LAN. It makes sense to let Windows be the foundation of your LAN applications only if most of your users are already running Windows applications on a frequent basis. Installing Windows on a network can be difficult and may not be worth the effort to satisfy the needs of a few isolated users.

It is important to determine which software will play the lead on your LAN. Will it be a DOS-based menu for selecting a mixture of applications, including Windows applications? Or will it be a Windows-based menuing system that will also control DOS applications? This depends not just on the overall percentage of DOS versus Windows applications, but on their frequency of use. The system administrator must take responsibility for studying these factors to determine which approach to take. If Windows applications are more frequently used (despite the availability of more DOS applications), then your LAN menu should be Windows-based.

Windows can have problems with PCs that don't adhere to common PC standards or that lack hardware "muscle." If there was ever a software package that could expose the idiosyncrasies of add-in memory boards, serial cards, network cards, printer ports, video cards, or anything else within a machine, it is Windows.

It is a misconception that installing Windows on a high-performance server can improve its performance on slower PCs. You might think, for example, that placing Windows on a 33-MHz 386 is likely to boost Windows' speed for an attached group of ATs. But Windows does not run on a server in the same way that a database application does. All Windows code is executed out of local RAM using your local processor. The server functions mostly as a storage device for some key Windows files.

The attraction of saving some space on local hard disk drives often tempts administrators to off-load the initialization and customization files onto the server, in addition to the executable files. Although this is possible, performance will drop appreciably, because Windows accesses these files frequently and will be forced to go over the network each time it needs them. For this reason, diskless PCs may not give users the performance they want from Windows. If your network consists mostly of slower or diskless PCs, you'd be wise to see a demonstration of the performance level before deciding to install Windows on a server.

The fact that a system provides greater ease of use to the end user does not mean it is easy to maintain. The LAN administrator's law of system management states that "as ease of use increases for the end user, so does maintenance complexity." LAN administrators should keep detailed records of configuration variations and prepare implementation plans for future maintenance requirements.

Defining Your Environment

Windows requires that you install a separate version for each unique hardware environment (i.e., computer) on the LAN. As such, it is imperative to identify and differentiate between varying computer platforms.

You can define your environment in two ways. First, determine all machine-specific variables that are relevant to the installation. This includes printers, video types, CPUs, mice, and so on. Second, determine your user-specific requirements, such as what applications they will be using, which printers they will be connected with, and what files they'll want to access. It is helpful to create a table of these items if you are working with a large network.

It is crucial to identify the lowest common denominator for machine-specific and user-specific groups. Review your machine-specific list and determine how many unique Windows configurations will be necessary. Logically group the users together in a fashion that minimizes the number of user-specific setups. You should install all variations of your hardware-specific list either on local hard disks or in separate shared directories on the network. Finally, define sufficient environmental variables to be able to distinguish between all machine-specific and user-specific variations.

When you have reached this point, you should write intelligent batch files to sample these environmental variables and determine which version of Windows should be run for each particular hardware configuration. For example, George Dart of Network Technology has developed batch files that query the client PC's network card and retrieve a serial number. The serial number acts as a pointer to a list of that machine's configuration parameters (e.g., RAM, CPU type, and video type). After these parameters are evaluated, the appropriate Windows version is launched.

The Shared Network Directory

If you are planning to install and run Windows from a shared directory on the network—for example, F:\\PUBLIC\\WIN30—remember to set all files in this directory to READ ONLY so that every user can access but not write to the files. You can do this from the Windows File Manager, from MS-DOS using the ATTRIB command, or from the networking software (e.g., NetWare) using the FLAG command. Most Windows applications must have READ ONLY status before they can be shared.

Microsoft recommends that the shared directory not contain the files SYSTEM.INI, WIN.INI, or WIN.COM. We, however, recommend that these files reside in the shared directory and that you install Windows versions for each hardware variation, making use of environmental variables. This way, you avoid problems that result from users logging into the network from machines other than their own (which may have a completely different set of hardware and user-preference characteristics). Each unique machine characteristic must remain constant with the system, independent of which user is using the machine.

continued

BYTE ACTION SUMMARY

Implementing Windows 3.0 on a Network

Networks have become essential to almost every business. So, in many cases, has the use of a windowing environment. With the next step, implementing Windows on a network, you will reap even more benefits. They include being able to access and manage your network resources, connect and disconnect remote printers, view and manage remote files, and view or change the status of print jobs on remote printers. To find out how to run Windows 3.0 on a LAN, consult this step-by-step tutorial.

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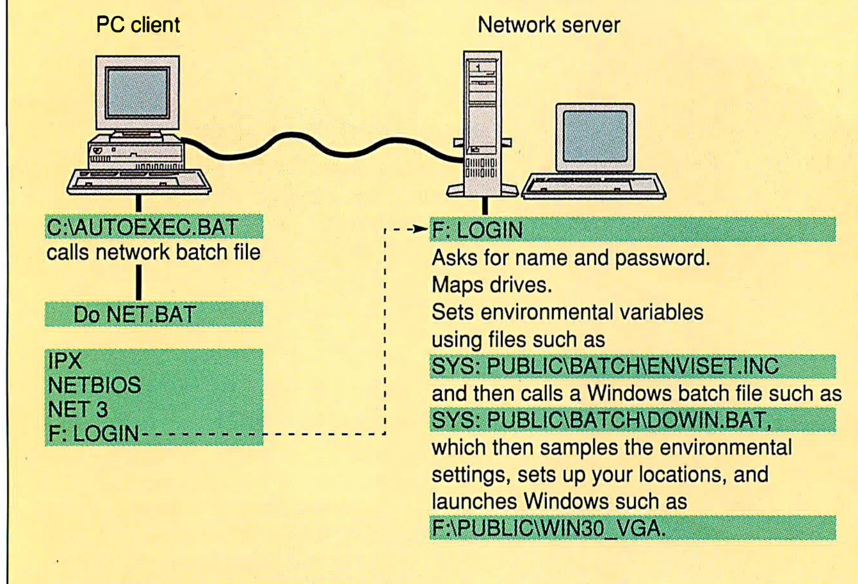
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You should plan on having some configuration files on the server, and others (as shown) on each client machine. Each configuration and start-up file has an appropriate location.

In many cases, network users take advantage of the MS-DOS SHARE command when files are shared between processes. If you want to run Windows from a shared network directory in some networking environments, the SHARE command can cause system problems, and it is best not to use it.

Make sure that the users' Windows directory and the shared Windows directory are in the PATH and in this order. For example,

PATH=F:\\USERS\\USER1;F:
\\PUBLIC\\WIN30

Menuing

Windows 3.0 comes fully equipped with an object-oriented menu front end that can use network search paths at the discretion of the administrator. You can easily configure Windows 3.0 menus for both individual users or groups, but users can encounter problems when they try to access their server files from different machines.

Dart, one of the pioneers of installing Windows in a network setting, claims that "the single biggest problem is for the administrator to overcome the mind-set of 'one user to one machine.' Users have a tendency to swap, borrow, or otherwise log into machines that are not their own. Administrators thus have to differentiate between machine-specific settings in Windows, such as video type, and user-specific variables, such as screen colors and preferred printers."

You should build flexibility into log-in scripts. If a user who normally logs in from a VGA system logs in from a machine with a CGA monitor, the log-in script must be able to detect this to prevent the system from hanging.

Printing on the Network

Often, a large LAN environment can have many different printers in use. Since most users find it tedious to page through multiple printer selections each time they start an application, it is important to display only those printers that will be used most often. You must be careful to configure the system properly. Windows can make use of environmental variables to achieve the desired result.

Printing on the network using Windows 2.11 was relatively straightforward, provided that you did not have more than three local and/or network printers. The Windows Control program allowed the linking of printers to the LPT1, LPT2, and LPT3 logical devices. This corresponds with Novell's ability to "capture" print queues to LPT1, LPT2, and LPT3. As an example, if you had just a local dot-matrix printer, a networked Hewlett-Packard LaserJet, and a networked PostScript printer defined, it was easy to configure the system using LPT1, LPT2, and LPT3. However, if you were confronted with more than three printers, you had to use environmental variables to preselect the desired printers before entering the master Windows program. The unwelcome alternative was to extensively train users in the use of the Control program.

Although this problem has not been completely overcome in Windows 3.0, the situation has significantly improved; you can directly access network queues, so you (or users) can see what print jobs are in the queue, delete print jobs, and reselect printers easily. The users should set their defaults via the CAPTURE command in their initialization batch file before loading Windows, eliminating the need to use environmental variables.

Avoiding Problems

Sometimes, network operating software is loaded into upper memory (640K bytes to 1 megabyte) or high memory (the first 64K bytes above 1 MB). There is a good chance that this will cause Windows to lock or fail during operation. If this happens, try loading the network software in conventional memory (the first 640K bytes). (See the section on QEMM.SYS 5.1 in "Making Windows Work" for more information.)

Although SETUP modifies the PATH statement in your AUTOEXEC.BAT file, make sure that this statement appears before any network calls. Most network log-in scripts or procedures can redefine the path and map drives. Make sure that the network PATH and MAP statements are set properly for your Windows configuration.

If you have problems with SETUP for a machine on a network, try SETUP /I when you run SETUP. The /I option disables SETUP's hardware detection abilities. However, this may only be a short-term fix. For example, most ARCnet network interface cards (NICs) use a default base address of 2E0 hexadecimal that runs in direct conflict with SETUP's desire to test for an 8514 video card. If you are not using (and never plan to use) an 8514 video card, the SETUP /I options solve this conflict. A more complete solution would be to change the base address of the NIC to somewhere in the 300h-to-340h range.

If you are experiencing poor performance from your network printer (e.g., bad page breaks, wrong font selections, or blank lines), you may need to change your NetWare print job configuration. Using the PRINTCON utility, set the Auto Endcap and Enable Timeout settings to "no."

continued

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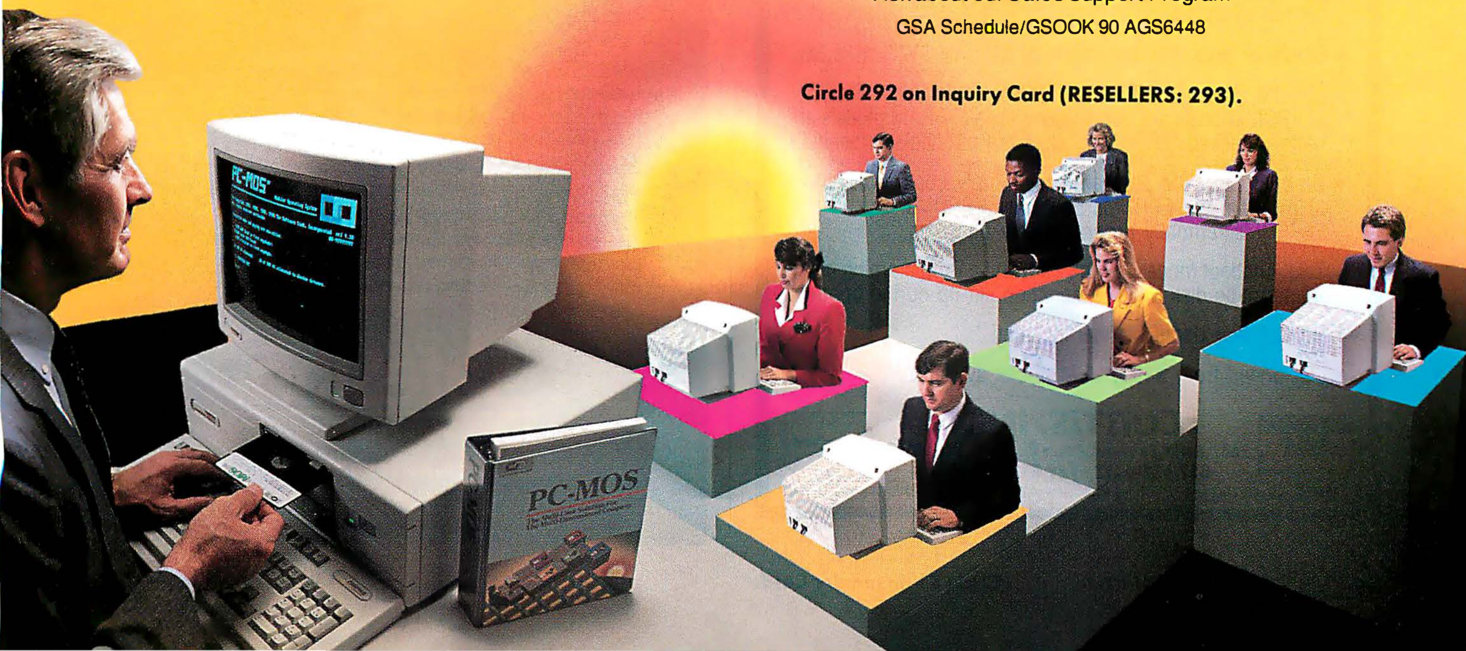
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Under Windows 2.11, the WIN.INI file was usually the Achilles' heel for most networks. Windows 2.11 had the annoying feature of writing only part of the modified WIN.INI file to the currently resident directory location. These directory locations containing partial or "orphaned" WIN.INI files resulted in unpredictable program execution. The LAN administrator needed to have the system configuration disciplined so that this would not occur. Under Windows 3.0, the condition has been corrected by making the Program Manager aware of the location of the various master .INI files. (See the text box "SYSTEM.INI Settings" on page 306.)

Novell Networks

Windows is compatible with NetWare 2.10 or higher. Both the network shell components and NetWare utilities must be version 3.01 or higher. These files include NET3.COM, NET4.COM, NETBIOS.EXE, IPX.COM, and BINDFIX .EXE.

While you are at a DOS prompt in Windows, you should never attempt to log in, log out, or attach to the network server—it will hang your system. Always perform these functions from the Windows Control Panel.

If you are seeing file error messages, you most likely need to increase your file handle size from the NetWare default of 40 files to 60 files. You can do this by adding the following line to SHELL .CFG:

```
file handles = 60
```

If you want to show the directory entries dot (.) or double dot (..) in NetWare (as MS-DOS would), add the following line to SHELL.CFG:

```
show dots = on
```

The NetWare 3.01 shell can emulate these entries without problems in Windows (earlier versions of the NetWare shell will cause problems). This helps applications when they're listing files and directories.

When Windows is installed for NetWare, SETUP adds the loading of the utility NWPOPUP to the [WINDOWS] section of your WIN.INI file:

```
load=nwpopup.exe
```

This utility displays all your incoming network broadcast messages. If you want to take advantage of SWAPFILE, however, you must first temporarily disable NWPOPUP. You can do this by selecting the Disable Broadcast Messages option from the Network section of the Control Panel. (See chapter 13 of the Windows User Guide on setting up Swapfiles.)

Mapping NetWare Drives

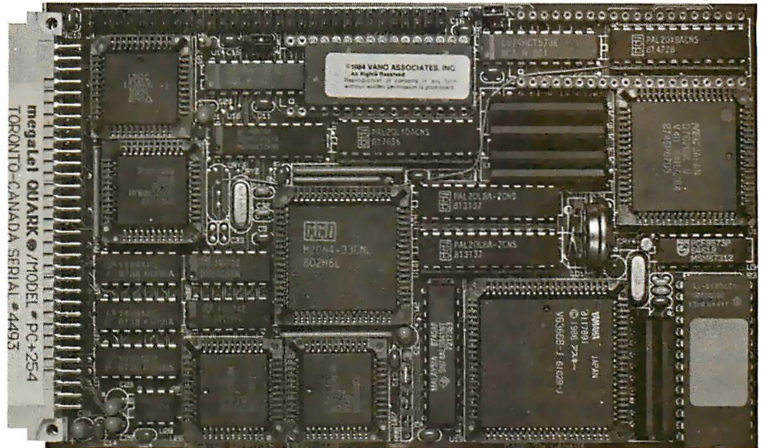
If you redirect drives through mapping techniques—for example, if drive G on your path represents the mapped physical directory SERVER\\SYS VOLUME \\USER\\USER1—Windows will only show the root directory (`Server\Sys Volume`) and in some cases may actually redirect the drive itself to the root directory. To correct this situation, you must use the MAP ROOT command for each drive you want mapped before starting Windows. The MAP command should now read as follows:

MAP ROOT G: =SERVER1\\SYS:
ONE\\USER\\USER1

continued



dma



SYSTEM.INI Settings

You can modify many of the settings included in the SYSTEM .INI file to correct or improve Windows' performance on a network. A unique version of SYSTEM.INI must reside in each user's personal Windows directory or match the user's environment settings. Therefore, each version of SYSTEM.INI has to be modified to have the full effect. Here are some descriptions and suggestions regarding the most critical settings.

The [Boot] Section

`Network.drv=` Specifies the network driver filename you are using; the default is none. Most network driver choices are available using SETUP. You modify this setting by choosing the SETUP icon located in the Main group window and modifying your network choice. If you want to install a network driver that Windows doesn't provide, you need to run SETUP all over again from MS-DOS.

The [Standard] Section

SYSTEM.INI's [Standard] section controls systems running in standard mode.

`Int28Filter=` A numeric setting that determines the number of INT28 hexadecimal interrupts that are generated to software loaded before Windows while your system is idle. The default value is 10. Increasing the value improves Windows' performance but can cause conflicts with memory-resident software such as network shells. Changing the setting to 0 eliminates the interrupts. Users of communication applications on a network should be aware that the lower the value of `Int28Filter`, the higher the system overhead, which can cause conflict with the communication application.

`NetAsynchSwitching=` Controls whether Windows provides the ability to switch away from an application after it has made an asynchronous NetBIOS call. The default value of 0 establishes that task switching is not available. With a value of 1, task switching is available. Network users should determine if any of their applications will receive network messages while switched to other applications; if an application does receive messages and you have a setting of 1, your system may fail.

`NetHeapSize=` A numeric setting (in kilobytes) that determines the size of the buffer pool allocated in conventional memory (640K bytes) for moving data over a network. The default value is 8, but many networks require a bigger buffer size. The larger the buffer size, the smaller the amount of memory provided to applications.

The [386Enh] Section

SYSTEM.INI's [386Enh] section controls 386 systems with at least 2 megabytes of memory and running in enhanced mode.

`AllVMsExclusive=` A Boolean setting that controls whether an MS-DOS application can run in a window or must run in exclusive full-screen mode, regardless of the settings in the program information file. The default setting is false. If the setting is true, network users will see an increase in the time it takes for Windows sessions to be completed.

`FileSysChange=` A Boolean setting that controls whether the File Manager automatically receives messages from non-Windows applications when those applications create, delete, or rename files. If the setting is false, a virtual machine can perform file manipulation while running independently of the File Manager. If it is true, all messages automatically go to the File Manager, and system performance is degraded.

`InDOSPolling=` A Boolean setting that determines whether other applications can run when memory-resident software has the `InDOS` flag set. The de-

This will make the directory USER\\USER1 appear to be the root of drive G.

We recommend that you only use the MAP ROOT command for directories with program files. The MAP command should be used for directories with data files so that the user can move around within subdirectories. Here is an example:

```
MAP ROOT G:SERVER1\\SYS:ONE
    \\PUBLIC\\WINAPPS
MAP S:SERVER1\\SYS:ONE\\
    USERS\USER1\WINDATA
```

Windows in enhanced mode can do some additional adjusting of your network drive mappings. In standard mode, all drive mappings that are changed while inside Windows are reset to the original mappings when you exit Windows. For example, changing drive G to represent \\PUBLIC\\WINAPPS from \\USER\\USER1 will be reset to \\USER \\USER1 on exit. In enhanced mode, you can make all drive mappings stay in place even after leaving Windows by adding the following line in the [NETWARE] section of your SYSTEM.INI file:

```
RestoreDrive=False
```

The default for each virtual machine in enhanced mode is to have its own (Local) set of drive mappings. Thus, changing the mapping in one machine does not affect the other. If you want to have mapping (or any mapping change) affect all virtual machines (Global), use the following setting in the [NETWARE] section of SYSTEM.INI:

```
NWshareHandles=True
```

Microsoft LAN Manager

Early versions of LAN Manager 1.x will not run with Windows; they will need to be upgraded. Also, you should be aware that the software cannot be loaded into high memory.

LAN Manager 1.x Enhanced includes pop-up services that enable you to see incoming broadcast messages. This feature can cause problems with Windows' display.

If you want to have pop-up services, you use the LAN Manager `WinPopup` utility, which is designed to work with Windows. The utility should be located in the LAN Manager NETPROG directory and should also be included in your path.

To have the utility start with Windows, you would use the load option in the [WINDOWS] section of WIN.INI, as follows:

fault setting is no. You must change the setting to yes if your memory-resident software needs to be in a critical section to perform operations off an INT28 hook. When the setting is yes, system performance is degraded.

`INT28Critical=` A Boolean setting that specifies whether a critical section is required to handle INT28h interrupts for a memory-resident software application. The default setting is true. If your network's virtual device does internal task switching on INT28h interrupts and the system is crashing, you may need a critical section. If you do not need a critical section, change this setting to false; this should improve Windows' task switching.

`NetAsynchFallback=` A Boolean setting that can require Windows to try to save a NetBIOS request if it is failing. The default setting is false. Windows has a global network buffer to handle data; if sufficient space is not available in this buffer when an application makes a NetBIOS request, Windows fails the request. If you change this setting to true, Windows tries to save the request by creating a buffer in local memory and preventing all virtual machines from processing until the data has been properly received and the time-out period has passed. The time-out period is controlled by `NetAsynchTimeout`.

`NetAsynchTimeout=` A setting (in seconds to one decimal place) that determines the length of a time-out period if Windows is attempting to save a failing NetBIOS request. The default is 5.0 seconds and applies only if `NetAsynchFallback` is set to true.

`NetDMASize=` Determines the buffer size (in kilobytes) for NetBIOS transport software. The buffer size always represents the largest value established by this setting or the value established by `DMABuffersize`.

`Network=` Represents the 386 enhanced-mode synonym for `Device`. The default is none and is controlled by SETUP.

`PSPIncrement=` A setting (numerical from 2 to 64) that tells Windows to reserve, in 16-byte increments, additional memory for each successive virtual machine if `UniqueDOSPSP` is true.

`ReflectDOSInt2A=` A Boolean setting that tells Windows to run through or reflect DOS INT 2A signals. The default is false, which instructs Windows to run through this type of signal, providing more efficiency. If you have memory-resident software that requires knowledge of INT2A messages, change the setting to true.

`TimerCriticalSection=` A setting (in milliseconds) that tells Windows to go into a critical section around any timer interrupt code and use the time-out period specified. A value greater than 0 guarantees that only one virtual machine at a time will receive time interrupts. Some network memory-resident software will fail if a value greater than 0 is not used. System performance slows with the use of this setting.

`TokenRingSearch=` A Boolean setting that instructs Windows to look for a Token Ring network adapter on machines with the IBM AT architecture. The default is true. This search can interfere with another device.

`UniqueDOSPSP=` A Boolean setting that can instruct Windows to start every application at a unique memory address (PSP). The default setting is false. If the setting is true, each time that Windows creates a new virtual machine to start a new application, a unique amount of memory below the application is reserved. `PSPIncrement` controls the amount of memory that is reserved. This approach guarantees that applications in different virtual machines will start at different addresses. In some networks, the load address of the application is used to identify each process on the network.

```
load=winpopup.exe
```

If you do not want this feature, remove the `messenger` and `netpopup` arguments from the line `wrkservices` in LANMAN.INI (the LAN Manager root directory). For LAN Manager 2.0 Enhanced, Windows needs to have the DLLs NETAPI.DLL and PMSPL.DLL in the LAN Manager NETPROG directory and in your PATH.

Other Networks

For networks that support MS-NET and NetBIOS, be aware that the Print Manager cannot handle multiple print queues, so print jobs may be listed improperly.

To run Banyan Vines 4.0 with Windows in enhanced mode, you need to obtain patch 'OH.' When running Windows in enhanced mode, you can run only one application at a time that makes use of NetBIOS. For example, if you are printing to a remote printer from a Windows application or running an application that uses NetBIOS, be sure to close all other virtual machines.

Also, you should remember that if you want to use Windows printing functions and run non-Windows applications with Vines 4.0, you need to have NetBIOS loaded.

For 3Com networks, be aware that 3+Share and 3+Open LAN Manager use completely different drivers. Also, if you are going to use a 3Com XNS protocol stack, the following item must be included in the [386Enh] section of SYSTEM.INI:

```
TimerCritical Section = 10000
```

If you are not going to use the XNS stack and are having problems, just remove that line.

Final Thoughts

The key to installing Windows on a network is planning. Even though your user base may be pressuring you to install Windows right away, there is simply no substitute for a thorough definition of your requirements and an implementation plan.

Taking the time for such preparation may delay your initial installation. In the long run, however, it will save you time and effort. ■

Jeffrey H. Lubeck and Bruce D. Schatzman are systems consultants in the Seattle area. They provide systems design and implementation services throughout the U.S. You can reach them on BIX c/o "editors."

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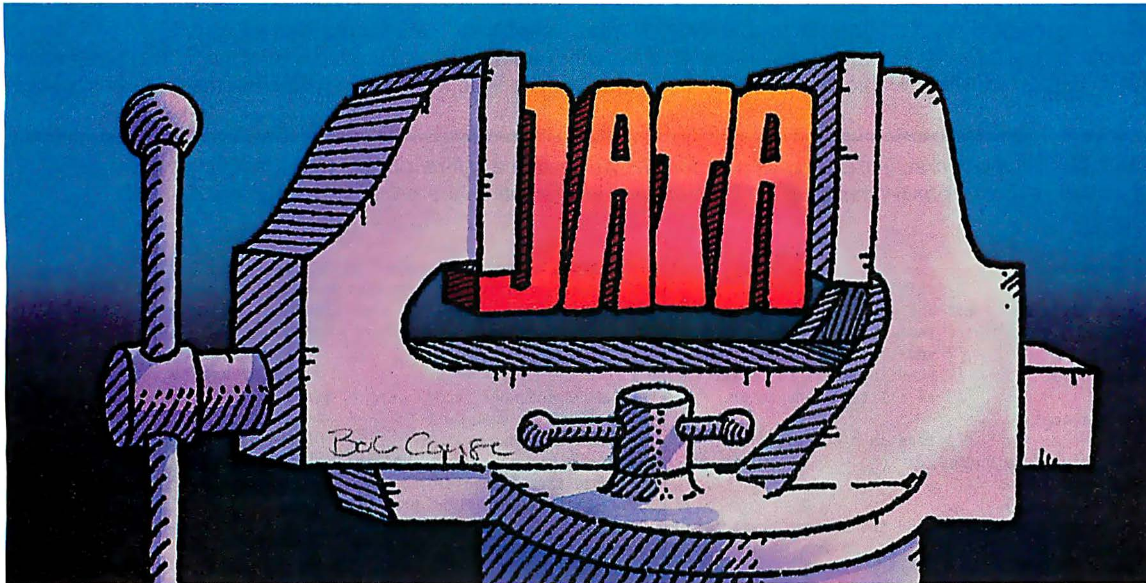
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LOSSLESS DATA COMPRESSION



Two algorithms—Huffman coding and LZW coding—are at the root of most compression

At first glance, the concept of data compression seems too good to be true. The idea of shrinking information without losing any of it looks to be a something-for-nothing proposition that violates what should be one of Newton's lesser-known laws: the law of conservation of data.

Despite the aura of mystique that surrounds it, data compression is based on a simple idea: mapping the representation of data from one group of symbols to another, more concise series of symbols. Data-compression programs and dedicated compression hardware use several different algorithms to achieve this end.

Two compression schemes, Huffman coding and LZW coding (for Lempel and Ziv, its creators, and Welch, who made substantial modifications), form the basis for much of the compression that we use from day to day. These techniques also represent two distinct schools of compression algorithms. An understanding of how each algorithm works provides an excellent background in compression in general.

Both Huffman and LZW coding are *lossless* compression techniques. They are appropriate to use for compressing any kind of data because the expanded representation is identical to the original input to the compressor. Joint Photographics Experts Group (JPEG), Motion Picture Experts Group (MPEG) (see "Putting the Squeeze on Graphics," December 1990 BYTE), and other cutting-edge image-compression algorithms achieve fantastic compression ratios at the expense of exact data reproduction. These techniques work well for images and sound data, but they are not appropriate for general data.

Huffman coding, originally proposed sometime in the early 1950s, reduces the number of bits used to represent frequent characters and increases the number of bits used for infrequent characters. The LZW method, on the other hand, encodes strings of characters, using the input stream to build an expanded alphabet based on the strings that it sees. These two very different approaches both work by reducing redundant information in the input data.

Huffman Coding

Huffman coding is probably the best-known method of data compression. The simplicity and elegance of the technique have made it a longtime academic favorite. But Huffman codes also have practical applications; for example, static Huffman codes are used as the last stage of JPEG compression. The MNP-5 data-compression standard for modems (see "4800 Bits, No Errors," June 1989 BYTE) uses dynamic Huffman compression as part of its process. Finally, Shannon-Fano coding, a close relative of Huffman coding, is used as one stage in PKZIP's powerful "imploding" algorithm.

continued

Huffman coding works on the premise that some symbols are used more often than others in data representation. The most common representation, the ASCII alphabet, uses 8 bits for each character. In English, the letter *e* is considerably more likely to appear than the letter *q*, yet we use the same number of bits to represent each. If we used only 4 bits for an *e* and 12 bits for each *q*, we would save some bits whenever storing English text.

Huffman coding formalizes this idea of relating symbol length to the probability of a symbol's occurrence. Static Huffman coding requires you to have a table of probabilities before you begin compressing the data. This table can be compiled from statistical observations (such tables have been compiled for inputs like English), or the compressor can prescan the input data to find the symbol probabilities before it starts to compress the data.

The compressor and decompressor can construct an encoding tree with this probability information. The encoding tree is a binary tree with one leaf for each symbol. To construct the tree, the compressor starts with the two symbols of lowest probability. It then combines these two as two leaf branches under a node; this node, in turn, is assigned the sum of the two probabilities. The compressor then considers this node along with the rest of the symbols in the probability list, and it again selects the two least probable items. It continues to build and combine nodes until it builds a single tree, with the probability at the root equal to 1.

The resulting tree has leaves of varying distance from the root. The leaves that represent the symbols with the highest probability are closest to the root, while those with the lowest probability are the farthest away.

To encode a symbol, the compressor finds the path from the root of the tree to

Listing 1: *Dynamic Huffman compression/expansion pseudocode. All structure references are simplified for readability. Unless explicitly noted, structures are elements of the* Tree *array. For example,* char.parent *should properly read* Tree[char].parent.

```
PROCEDURE huffman compress
tree <- ROOT                              // initialize the tree
add_node (empty leaf, ROOT, 0) // add the empty leaf to the tree
char <- (next character from buffer)// read in the first character
add_node(char, ROOT, 1)                   // add this char to the tree
write char to output buffer               // send the first character
                                          // as a literal character
WHILE (input buffer not empty)
                                          // read in a character
   char <- (next character from buffer)
   IF (char is not known)
      transmit(empty leaf code)
      write char to output buffer  // send the literal character
      update_tree (empty leaf code)// adjust the tree
      IF (all nodes not full)
                                          // add to the tree
         add_node(char, empty leaf, 1)
                                          // move empty leaf
         add_node(empty leaf, empty leaf, 0)
      ELSE                                // last node to add
                                       // assign empty leaf info to char
         char.parent <- empty leaf.parent
   ELSE                                   // this character is known
      transmit(char code)
      update_tree (char code)             // adjust the tree
CONTINUE

PROCEDURE huffman expand
tree <- ROOT                              // initialize the tree
add_node (empty leaf, ROOT, 0)  // add the empty leaf to the tree
char <- (next char from buffer) // read in literal first character
add_node(char, ROOT, 1)                   // add this char to the tree
write char to output buffer               // write the first character
WHILE (input buffer not empty)
   char <- incode(buffer)                 // read in a code
   update_tree (char code)                // adjust the tree
   IF (char=empty leaf)
      char <- next char from buffer// read in literal character
      IF (all nodes not full)
                                          // add to the tree
         add_node(char, empty leaf, 1)
                                          // move empty leaf
         add_node(empty leaf, empty leaf, 0)
      ELSE                                // last node to add
                                        // assign empty leaf info to char
         char.parent <- (empty leaf.parent)
   write char to output buffer
CONTINUE
```

```
// Huffman compression support routines
// assume expander has same tree structure as compressor for
// readability. In reality, each expansion tree node has daughter
// pointers as well as a parent pointer.

                                          // add a node to the tree
PROCEDURE add_node (code, parent, branch)
code.parent <- parent                     // assign parent pointer
code.bit <- branch                        // assign bit for this code
code.weight_ptr <- (next available spot in weight list)
IF (code is a character)
  Weightlist[code.weight_ptr] <- 1
ELSE                                      //code is the empty leaf
   Weightlist[code.weight_ptr] <- 0
ENDIF

PROCEDURE update_tree(code)
WHILE (code != ROOT)
  Weightlist[code.weight_ptr] ++          // increment weight
  IF (Weightlist[code.weight_ptr] = MAXWEIGHT)
       scale(weightlist)
   IF (Weightlist[code.weight_ptr] > Weightlist[code.weight_ptr-1]
                                          // if weight is greater than
                                          // that of node listed above
                                          // it in the weight list
      swap_node<-(heaviest node, which is lighter than code)
      IF (swap_node != code.parent)// don't swap if parent-child
         swap(swap_node, code)
   code<-code.parent
CONTINUE

PROCEDURE transmit (code)                 // transmit a Huffman code
DO
   push code.bit                         // push this code's bit on a stack
   code<-code.parent                      // move to parent node
WHILE (code != ROOT)
pop bitstack                              // send the bits to output

PROCEDURE incode (buffer)                 // read a Huffman code
code<-ROOT                                // start at the root
DO
   bit<-(next bit from buffer)            // read in a bit
   IF (bit=0)
      code<-code.zero_daughter            // jump to zero child
   ELSE
      code<-code.one_daughter             // or one child
WHILE (code.daughter != NULL)             // until you find a leaf
RETURN code                               // leaf location is its value
```

the symbol's leaf. Suppose the compressor wants to encode the letter *s*. It starts at the leaf corresponding to *s* and jumps to the parent node, noting which branch (0 or 1) it was on. It continues to jump up the tree until it reaches the root. The list of branches, when reversed, describes the path from the root to *s*: This is the symbol's Huffman code.

High-probability characters are close to the root, so their codes are short. Low-probability characters are far from the root and have longer codes.

To decode, the decompressor takes the code and processes it in reverse. That is, it starts at the root of the tree. If the first bit in the code is a 1, it jumps to the node on the 1-branch from the root. It continues reading bits and jumping until it reaches a leaf; the symbol at the leaf is the decoded character.

One more property of the Huffman tree bears discussion. Because symbols are always leaves, symbol nodes never have any children. When the decompressor gets to a leaf node, it knows to stop reading from the input immediately because it knows it has reached a leaf. In other words, one Huffman code is never the prefix of another. This means that although code lengths are variable, the compressor always knows when one code ends and another begins, and there is no need to explicitly place delimiters between codes.

Dynamic Huffman Coding

The greatest difficulty with Huffman codes, as you probably noticed from the discussion above, is that they require a table of probabilities for each type of data to compress. This is not a problem if you know you will always compress English text; you simply provide a suitable English text tree to the compressor and decompressor. The JPEG protocol defines a default Huffman tree for compressing JPEG data. In the general case, when you don't know the symbol probabilities for your input data, static Huffman codes can't be used effectively.

Fortunately, a dynamic version of Huffman compression can construct the Huffman tree on the fly while reading and actively compressing. The tree is constantly updated to reflect the changing probabilities of the input data.

Listing 1 contains a pseudocode version of a dynamic Huffman compression/decompression program. The actual code, which is available from the usual sources, is written in 8088 assembly language. These programs are based on an algorithm described in reference 1, which cites a number of original sources. Reference 2 presents a more efficient, although complex, algorithm for dynamic Huffman compression.

The key to starting with an uninitialized tree is the introduction of an empty leaf. The empty leaf is simply a leaf node with no symbol attached to it; this leaf has zero probability. The initial tree, held by both the compressor and decompressor, has only the root and a single empty leaf.

The compressor starts the ball rolling by reading in a character. It attaches this character to the 1-branch of the root, leaving the empty leaf on branch 0. It then sends this character to the decompressor as a literal ASCII code, and the decompressor makes the same adjustment to its tree.

For each character read thereafter, the compressor performs the following steps. First, it checks to see if the code is

in the encoding tree. If the code is there, the compressor sends it in the same fashion as in the static case. If not, it sends the code for the empty leaf. Then it sends the new character as a literal ASCII code. Finally, the compressor adds two codes, one for a new empty leaf on branch 0 and one for the new code on branch 1. When the tree is full (i.e., when all characters have been seen), the compressor just changes the last empty leaf node into the last character.

The decompression program can make adjustments to its tree because it has exactly the same tree as the compressor. When it receives an empty leaf code, it reads the next code from the compressed data as an ASCII literal. It then employs the same update routine as the compressor uses to update the tree.

The empty leaf and the uninitialized tree don't solve the problem of keeping track of changing probabilities, however. To do that, you need to introduce weights to each node in the tree and update these weights as you process the input data. You also need to maintain a list of node designations (and weights) sorted by weight.

Each character starts at weight *1* (the empty leaf starts at 0). Whenever the compressor transmits a character that is in the table, it increments the weight of that character's node. If this change makes the character node heavier than nodes that are listed higher in the weight list, the compressor swaps the character node with the heaviest node that is lighter than the character node. By *swapping*, I mean trading parent nodes and branch designations only; the children of the swapped nodes are not affected, so there is no danger of a leaf node becoming internal, or an internal node becoming a leaf.

The compressor then jumps up the tree to the character's parent, which may have changed with the last swap. It continues the process with the parent and on up the tree until it gets to the root.

The figure shows the early stages of dynamic Huffman tree construction for a very simple input. You can follow the addition of new leaves via the empty leaf mechanism as well as by node swapping in this diagram.

Huffman Gotchas

As usual, there are a few snags when you're actually implementing the dynamic algorithm, regardless of its elegance. The first problem is that you can't perform node swapping while transmitting a code, although both require you to start at a character node and hop up the tree parent by parent. You can't do the two procedures at the same time, because swapping nodes causes the parent to change, which causes the code transmitted to change. You would send a code to the decompressor before it knows what to do with it.

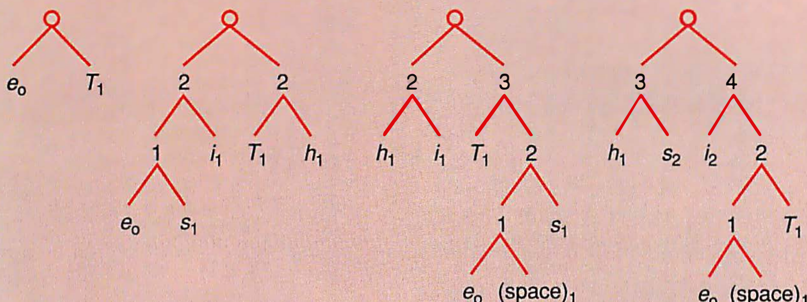
A way around this dilemma is to make two passes in the compressor—one for transmitting and one for updating. The decompressor also makes two passes—one for receiving (going down the tree) and one for updating (going back up).

The second problem occurs because of the empty leaf. Because the empty leaf has zero weight, it is possible for a sibling of the empty leaf to become heavier than its parent at the start of the update process. However, swapping between child and parent will scramble the tree, leaving the parent as its own child. Fortunately, simply aborting any swap between child and parent solves the problem.

Finally, there isn't any way for the

DYNAMIC HUFFMAN TREE CONSTRUCTION

Input: This(space)is



Tree after T | After s | After (space) | Final tree

e_0 = empty leaf
T_1 = node T, weight 1
Other numerals indicate node weight

Output:
T0h00i100s000(space)01111
T h i s (space) i s

The Huffman encoding tree changes to respond to changing character probabilities in this dynamic example. At first, all the transmissions are empty leaf code/literal character combinations. When i *and* s *are transmitted a second time, the compressor uses their codes instead of literals. As* s *is reused, it moves higher up the tree, shortening its corresponding code.*

LZW COMPRESSION

Table 1: *An instance of compression, at code 258. The compressor saves a code by transmitting 258 instead of* is, *the literal representation. Strings are stored in the LZW table as code-character combinations rather than full strings.*

Input	Compression table	Compressed string	Expansion table
T	—	—	—
h	256←T+h	T	—
i	257←h+i	h	256←T+h
s	258←i+s	i	257←h+i
(space)	259←s+(space)	s	258←i+s
i	260←(space)+i	(space)	259←s+(space)
s	—	—	—
(space)	261←258+(space)	258	260←(space)+i
a	262←(space)+a	(space)	261←258+(space)

decompressor to detect the end of transmission if the compressor must send out full bytes (as in a file-compression program). Suppose, for example, a transmission is 81 bits long. When the decompressor reads the first bit of the eleventh byte, it has no way of knowing that it's the last significant bit and that the remaining 7 are garbage. Therefore, the file-compression code must prepend a file length to the compressed data, making it a few bytes longer.

LZW Compression

The LZW algorithm, which was first presented by Welch in 1984 (see reference 3), has become a widely used technique during the last few years. CompuServe's GIF file format uses LZW compression, as do ARC, Unix's `compress`, Stuffit, and PKZIP. The algorithm itself is patented by Sperry.

Although straightforward in concept, the LZW algorithm can be a little difficult to implement on a real machine with real constraints. Despite some complexities, however, the technique is powerful and fast enough to make it popular.

LZW works by extending the alphabet—it uses the additional characters to represent strings of regular characters. To use LZW compression on 8-bit ASCII codes, you extend the alphabet by using 9-bit or larger codes. The additional 256 characters that the 9-bit code gives you are used to store strings of 8-bit codes, which are determined from strings in the input.

The compressor maintains a string table with strings and their corresponding codes. The string table corresponds to the extended alphabet. Initially, the compressor starts with a string table with only the 256 literal codes defined. If you're using 9-bit codes, the string table has an additional 256 empty entries; if you're using 10-bit codes, it has 768 empty entries, and so on.

The compression algorithm works like this: Start with a null string. Read in a character, and append it to the string. If the string is in the string table, continue reading and appending characters until you find a string that is not. Add this string to the string table. Write the code for the last known string that matched the output. Use the last character as the basis for the next string, and continue reading until you run out of input. That's really all there is to it.

Table 1 shows an example of LZW compression, using the same simple input in the figure. The compressor reads in the initial *T* and appends it to the null string. The string *T* is a literal character, so it is in the table. Next, the compressor reads an *h* and looks up *Th* in the string table, where it doesn't find it. It adds *Th* to the table at the next available position and sends out the last known string, *T*. It continues reading characters and adding strings until the input is exhausted.

This short and simple sample input shows only one instance of compression, when the code 258 is sent out instead of the string *is*. If I were using 9-bit codes, I would have sent eight 9-bit codes to represent *This is a* for 9 bytes either way and for break-even performance. Longer, more realistic inputs, of course, let you build a longer and more effective string table. The more repetitive that strings appear, the more you can compress.

Unfortunately, this simple compression algorithm eats memory like popcorn. Every time the compressor finds a new string, it adds it to the table. Each string that it adds is of variable length, which can lead to a storage nightmare.

Luckily, there is a simple way out. As you may have noticed, each new string is actually an old string plus a new character. Instead of storing strings explicitly, you can store them as code and appended character combinations. Table 1 shows this storage method. Code 261, for example, is stored as 258+(space) rather than "*is*(space)", which is the string that it represents.

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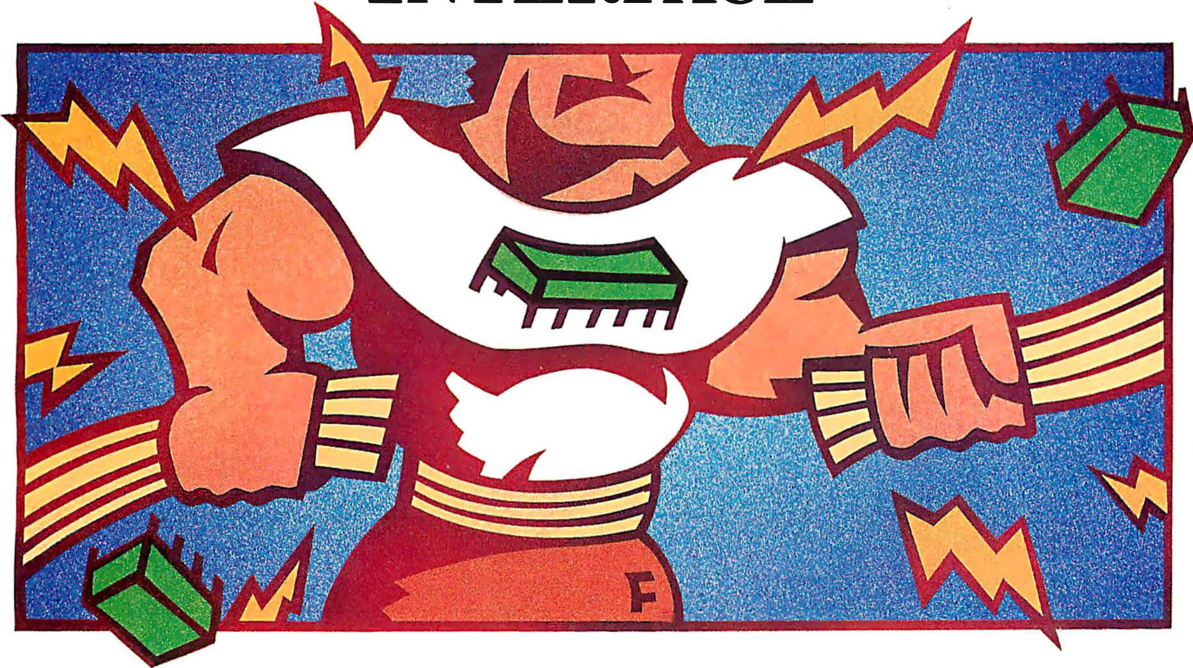
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ROGER C. ALFORD

THE IDE HARD DISK DRIVE INTERFACE



A de facto standard interface threatens to displace ST506, ESDI, and SCSI for most AT-class systems

Seasoned computer users recognize the names of the common hard disk drive interfaces: ESDI, ST506, and SCSI. Now there's a new kid on the block—Intelligent Drive Electronics.

The IDE interface, also known as the AT bus interface, turns up in more and more AT systems nowadays. IDE combines features of the other three interfaces and adds some extra benefits of its own. It's already a preferred interface and a de facto standard in the AT industry, and it's on its way to becoming a full-fledged ANSI standard. IDE will likely be the demise of the ST506 interface, and it will banish ESDI and SCSI to use in only the highest-capacity applications in AT systems.

The physical IDE interface is little more than an extension of the AT I/O-channel expansion bus. The actual hard disk drive controller is integrated onto the circuit board of the hard disk drive. As a result, IDE is a very simple interface from a circuit standpoint: some bus buffers, address decoding, and little else. A single ribbon cable connects the drive to the host system, attaching to mating header connectors on the host and drive. The interface circuitry is so simple and inexpensive that it can be easily integrated directly onto the motherboard of an AT system, freeing the expansion slot that's required to accommodate a standard hard disk drive controller. (In case you're wondering, most IDE implementations also provide floppy disk drive support on the motherboard.)

The IDE drives are fast like ESDI drives and intelligent like SCSI drives, and they look like standard AT ST506 interfaces to the system. Most IDE drives have 34 or more sectors per track and run at a 1-to-1 interleave—the same as typical ESDI drives. The 1-to-1 interleave results in very high performance. Most of these drives also have a 32K- or 64K-byte memory buffer that allows sector caching, resulting in even faster effective operation.

Making the IDE interface appear the same to the system as the ST506 controller that's traditionally included with AT systems (including IBM's original 6-MHz model) allows these computers to use IDE drives with the standard AT ROM BIOS; no BIOS modifications or extensions are required. And even with its several advantages, the overall cost of an IDE hard disk subsystem is less than that of the alternatives.

In short, the IDE interface is a great idea. Figure 1 shows a traditional AT ST506 implementation; figure 2 shows an IDE implementation.

A Historical Perspective

Compaq provided the initiative that led to the development of IDE. In late 1984, Compaq approached Western Digital, a leading manufacturer of hard disk drive

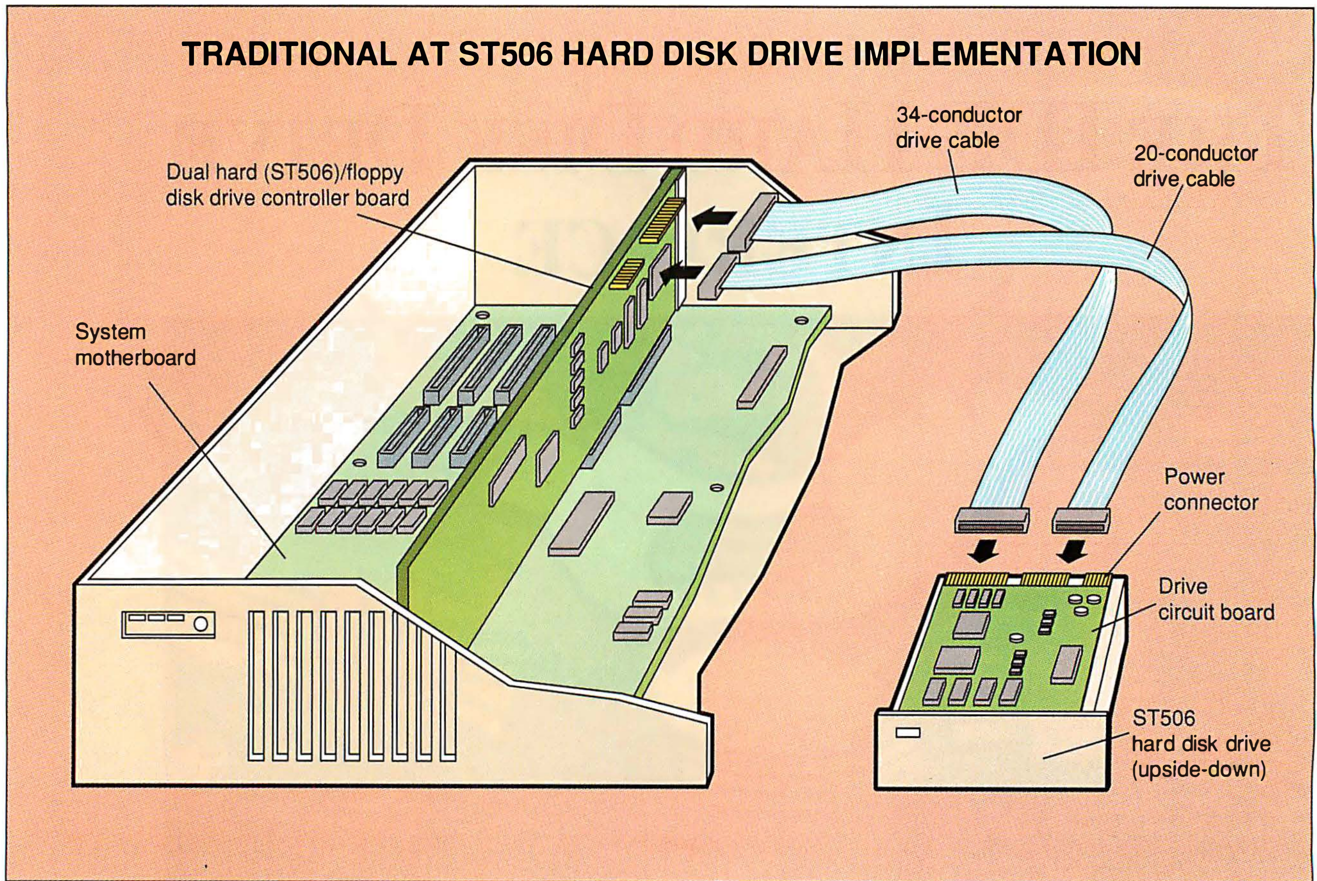


Figure 1: *A traditional AT ST506 hard disk drive implementation.*

controllers, about developing an ST506 controller that could be mounted directly onto a hard disk drive, with a single 40-conductor ribbon cable connecting the controller to a simple interface circuit at the system. This project was the birth of the IDE interface.

Compaq then approached Imprimis (which is now part of Seagate) in 1985 to integrate the controller electronics onto the circuit board of one of Imprimis's Wren drives. Working under an aggressive development schedule, Imprimis succeeded in integrating the Western Digital circuitry onto the Wren drive controller board, creating the first IDE hard disk drive. Compaq became the first computer manufacturer to ship IDE drives in its systems.

By integrating the controller circuitry onto the drive's electronics board, an entire circuit board and some of the interface electronics could be eliminated. The result was little additional cost to the hard disk drive, but a substantial savings in the hard disk drive interface.

Seeing the many benefits of the IDE interface over the standard interface alternatives, other drive manufacturers began to implement the interface on their drives, and more AT system makers began incorporating the drive interface into their designs. System manufacturers that did not yet include the IDE interface on their motherboards instead offered an adapter board, or "paddle board," that plugged into an expansion slot to support the IDE interface.

Over the past two years, the IDE interface has received phenomenal acceptance while continuing to evolve. Although IDE first appeared on 5¼-inch Wren drives, it really came into its own on 3½-inch drives, where it has become the dominant interface. It's also beginning to appear on the newer 2½-inch drives.

As usage increased, the lack of an official IDE standard left substantial room for variations in the implementation of the interface among drive vendors and system implementors alike. This resulted in a variety of irritating incompatibilities that kept the interface from working consistently for all IDE system and drive designs.

Increasingly aware of the variations in IDE implementations (as well as similar problems with SCSI implementations), a group of drive, system, and software manufacturers created a common-access-method committee to establish standards in these areas. The CAM Committee was formed in October 1988, and the first working document of the AT Attachment (ATA) interface (the new name assigned to the IDE interface) was introduced in March 1989.

After some revisions, an ATA draft proposal was finally submitted to the X3T9.2 ANSI working group in late 1990, and it is scheduled for processing sometime during the first half of this year. The interface is now on the road to becoming an official standard. (The technical information presented in this article is based on revision 2.1 of the CAM Committee ATA draft proposal.)

A Closer Look

Like SCSI, IDE is a logic-level interface, not a device-level interface like ST506 and ESDI. SCSI and IDE drives are intelligent; they accept high-level commands such as `Format Track` and `Read Sector`, and the electrical interface transfers commands and data between the system

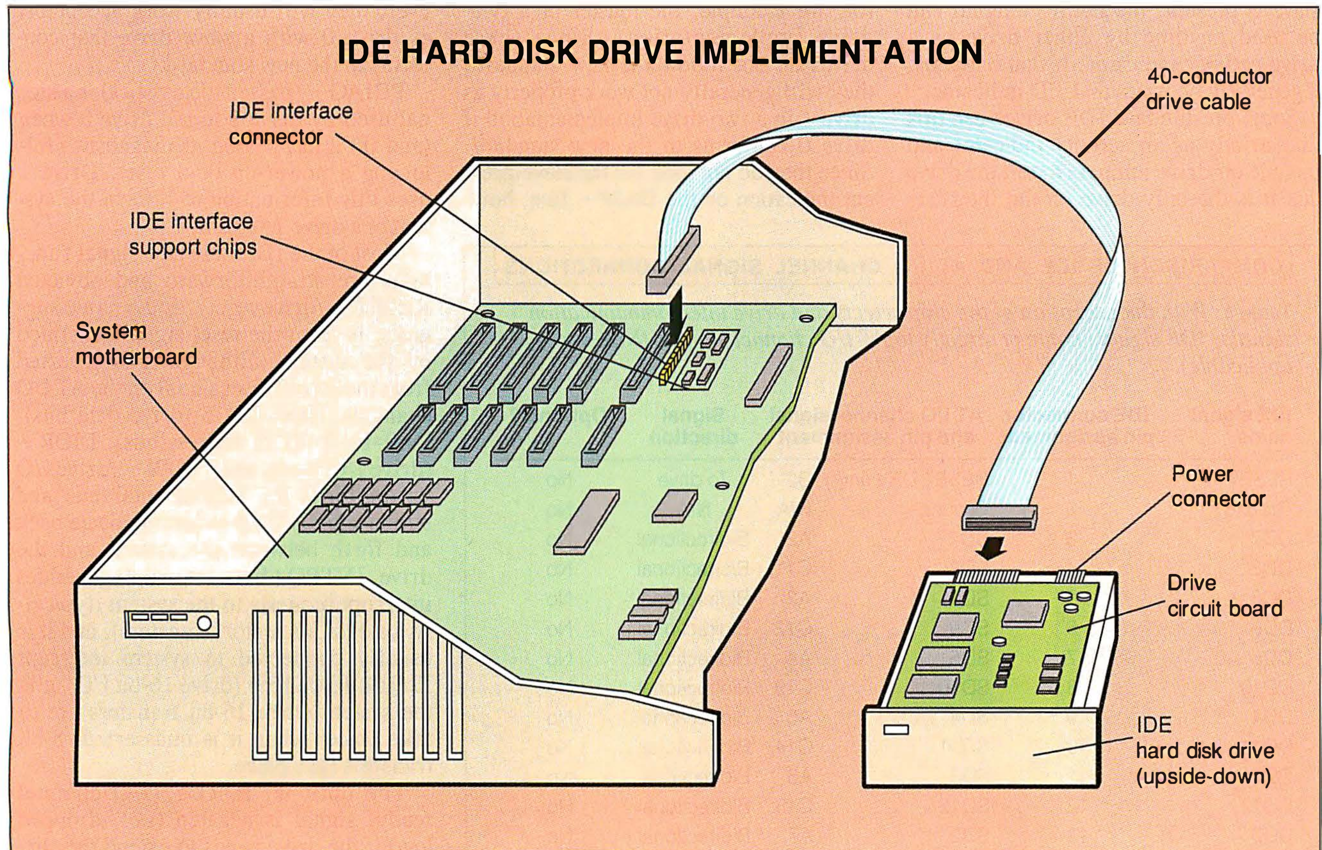


Figure 2: *With IDE, the hard disk drive controller moves onto the hard disk, freeing an expansion slot. Simple, inexpensive circuitry on the motherboard is all that's needed to accommodate an IDE drive.*

and the drive in 8- or 16-bit chunks.

By contrast, an ST506 controller must control every low-level operation of the attached drive, including head selection and stepping to tracks. This means that intelligence has to reside on the ST506 controller. Much of the magic of IDE comes from the intelligence of the drives. While looking at the technical specifics of IDE, keep in mind that the electrical interface itself is very simple, and all the significant functional electronics are on the drive itself.

The IDE interface consists of 40-pin header connectors on the system and on the drive, and a single interconnecting 40-conductor ribbon cable. Pin 20 is removed from the header connectors and plugged into the cable connectors to prevent the cable from being incorrectly connected. Most of the IDE signals connect directly to AT I/O channel signals. Table 1 shows the IDE interface signals, along with signal directions and their respective AT I/O channel signal connections. All the IDE signals are TTL-compatible. Note that some signals are optional.

The only IDE signals that do not directly connect to AT I/O channel signals are CS1FX−, CS3FX−, SPSYNC, DASP−, and PDIAG−. The first two signals are the chip selects (address decoding signals) for the drive command-block registers and control-block registers. For compatibility with the IBM standard ST506 hard disk drive controller, the chip selects are active in the 1F0 to 1F7 and 3F0 to 3F7 I/O-addressing ranges. The control registers for the AT floppy disk drive controller are also in the 3F0 to 3F7 range but are not present on the IDE drive. Table 2 lists the various hard disk drive registers defined at these addresses; for completeness, I have also listed the floppy disk drive controller registers.

The IDE interface supports up to two drives on its 40-conductor cable in daisy-chain fashion. The primary drive, drive 0, is referred to as the *master*, while the secondary drive, drive 1, is the *slave*. A jumper, or switch, on each drive is used to determine whether it is drive 0 or drive 1. SPSYNC, DASP−, and PDIAG− are the drive intercommunication signals and are used in two-drive implementations. The optional SPSYNC (for spindle sync) allows the master drive to generate a synchronous signal (e.g., from the drive's index pulse) to the slave drive, allowing the slave to synchronize its rotation with the master. Disk mirroring would be one application for such synchronization; however, most existing IDE drives do not implement the SPSYNC signal. Some earlier IDE drives used pin 28 for the DALE (drive address latch enable) signal instead of SPSYNC. However, DALE is not required, and it serves no useful purpose.

DASP− (drive active/drive 1 present) is an open-collector signal that has different functions at different times. During power-on initialization or within 400 milliseconds of the time RESET− is negated (i.e., removed), drive 1 must assert this signal (i.e., pull it low) to inform the master of its presence. If the master does not see the signal asserted within 450 ms of when RESET− is negated, it assumes there is no slave drive. If the slave is present, it must then negate DASP− after it receives its first valid command from the system, or within 31 seconds (a good, round number), whichever comes first. After DASP− has been negated, or if no

slave is present, the DASP– signal can be used anytime by either drive as a drive-activity indicator. If that happens, it generally operates an LED indicator.

Some prestandard IDE drives use this line strictly as an activity indicator and include on-drive jumpers to tell the drive that it is the only drive on the interface (or, for example, the master of a two-drive implementation). Since these drives do not follow the new standard, they will generally not work properly as drive 1 in a two-drive implementation if drive 0 conforms to the new standard. Since they do not look for the slave-present indication on the DASP– line, however, they will usually work acceptably as drive 0 with a slave drive that conforms to the new standard.

PDIAG– (passed diagnostics) is a signal used by drive 1 to tell drive 0 when (and if) it has passed its diagnostics following a power-up or a reset. Drive 0 uses this information to inform the system of a drive 1 failure.

Most of the IDE interface signal functions are straightforward and obvious. RESET– (drive reset), as the name suggests, is from the reset signal generated by the system (although it is inverted from the actual reset signal on the AT I/O channel). DD0–DD15 (drive data bus), DA0–DA2 (drive address bus), DIOR– (drive I/O read), and DIOW– (drive I/O write) form the fundamental bus and strobe signals used to communicate back and forth between the system and the drive. INTRQ (drive interrupt) generates interrupt requests to the system (typically for data, or sector, transfers), and it is usually connected to system interrupt IRQ14. IOCS16– (drive 16-bit I/O) tells the system when 16-bit transfers are to take place; when it is unasserted, 8-bit transfers take place.

The optional IORDY (I/O channel ready) signal is negated (i.e., dropped low) if the drive needs to extend the current host transfer cycle; otherwise it's in a high-impedance state (a pull-up resistor resides on the system motherboard); most existing IDE drives do not use this signal.

Two other optional IDE interface signals are defined that should help future IDE drive implementations achieve even better performance: DMARQ (DMA request) and DMACK– (DMA acknowledge). Current ST506 data transfer operations (and, thus, virtually all existing IDE transfer operations) take place using programmed I/O (PIO); that is, the processor directly handles all data transfers between the controller and memory. The processor must, for example, read a word of data from memory, write it to the controller, and then repeat this process 255 times to transfer a single sector to the controller. By supporting DMA, the processor can "rest" while the DMA controller transfers the data from the system memory to the controller (on the IDE drive) or vice versa, at up to twice the transfer rate of PIO.

Before the introduction of the current IDE draft proposal, some IDE drive manufacturers, most notably Conner Peripherals, chose pin 21 for IORDY instead of the now-standard pin 27. As a result, some existing drives put IORDY on both pins 21 and 27 (for backward and

COMPARISON OF IDE AND AT I/O CHANNEL SIGNAL CONNECTIONS

Table 1: *With the exception of the chip selects and drive intercommunication signals, IDE signals connect directly to AT I/O channel signals (N/A = not applicable).*

IDE signal name	IDE connector pin assignment	AT I/O channel signal and pin assignment		Signal direction	Optional?
RESET–	1	RESET DRV (inv[1])	B2	To drive	No
Ground	2	Ground	N/A	N/A	No
DD7	3	SD7	A2	Bidirectional	No
DD8	4	SD8	C11	Bidirectional	No
DD6	5	SD6	A3	Bidirectional	No
DD9	6	SD9	C12	Bidirectional	No
DD5	7	SD5	A4	Bidirectional	No
DD10	8	SD10	C13	Bidirectional	No
DD4	9	SD4	A5	Bidirectional	No
DD11	10	SD11	C14	Bidirectional	No
DD3	11	SD3	A6	Bidirectional	No
DD12	12	SD12	C15	Bidirectional	No
DD2	13	SD2	A7	Bidirectional	No
DD13	14	SD13	C15	Bidirectional	No
DD1	15	SD1	A8	Bidirectional	No
DD14	16	SD14	C17	Bidirectional	No
DD0	17	SD0	A9	Bidirectional	No
DD15	18	SD15	C18	Bidirectional	No
Ground	19	Ground	N/A	N/A	No
(keypin)	20	N/A	N/A	N/A	No
DMARQ	21	DRQx	N/A	From drive	Yes
Ground	22	Ground	N/A	N/A	No
DIOW–	23	–IOW	B13	To drive	No
Ground	24	Ground	N/A	N/A	No
DIOR–	25	–IOR	B14	To drive	No
Ground	26	Ground	N/A	N/A	No
IORDY	27	IOCHRDY	A10	From drive	Yes
SPSYNC	28	N/A	N/A	Interdrive	No
DMACK–	29	–DACKx	N/A	To drive	Yes
Ground	30	Ground	N/A	N/A	No
INTRQ	31	IRQ14	D7	From drive	No
IOCS16–	32	–I/OCS16	D2	From drive	No
DA1	33	SA1	A30	To drive	No
PDIAG–	34	N/A	N/A	Interdrive	No
DA0	35	SA0	A31	To drive	No
DA2	36	SA2	A29	To drive	No
CS1FX–	37	N/A	N/A	To drive	No
CS3FX–	38	N/A	N/A	To drive	No
DASP–	39	N/A	N/A	From drive[2]	No
Ground	40	Ground	N/A	N/A	No

Notes:
[1]The IDE Reset signal polarity is inverted from the AT bus signal.
[2]DASP– is also an interdrive signal.

current compatibility), since the drives do not support DMA operations and do not need the DMARQ signal on pin 21.

The current IDE draft proposal specifies a maximum cable length of 18 inches, although it includes provisions for greater distances if signal integrity is controlled. Most IDE drive manufacturers specify a maximum cable length of 24 inches. Fortunately, there is a reasonable amount of leeway in these specifications. (I have seen IDE drives run successfully on 6-foot cables, although this is not recommended.)

IDE's cable length limitation is one of the few specifications that can be considered a notable drawback when compared to the several feet of cable that are allowed in ST506 and SCSI implementations. In reality, however, IDE drives rarely need to be more than 18 to 24 inches from the system interface connector, since the drives are mounted directly inside the AT chassis.

Being intelligent, IDE drives can accept and respond to many commands from the host system. You issue a command to the drive by initializing any appropriate support registers and then writing a command byte to the drive's command register (at I/O address 1F7 hexadecimal). The commands fall into two categories: mandatory and optional. The only mandatory commands are those supported by the original IBM AT ST506 hard disk drive controller.

The IDE commands (both the mandatory and the optional ones) further subdivide into three operational classes, according to how the drive handles the request. Upon receiving a Class 1 command, the drive sets the BSY (busy) bit in its status register within 400 nanoseconds. Upon receiving a Class 2 command, the drive sets the BSY bit, sets up its sector buffer for a write operation, sets the DRQ (data request) bit in its status register within 700 microseconds, and then clears its BSY bit. Upon receiving a Class 3 command, the drive responds the same as for a Class 2 command, but it is allowed up to 20 ms to set its DRQ bit. Table 3 lists the IDE commands described in the current draft proposal.

While it is impossible to discuss the operation of all the IDE commands in this limited space, the optional `Read Multiple` and `Write Multiple` commands deserve special note. Whereas the standard AT ST506 controller can only execute `Read Sector` and `Write Sector` commands, which require interrupt processing at the completion of each sector transfer, the IDE "multiple" commands permit multiple sectors to be transferred without intervening interrupts, yielding better data transfer performance.

AT Support of IDE Drives

Since the original intention was for IDE drives to work just like standard AT ST506 drives, most existing IDE drives support only the mandatory commands. As BIOS support for the optional commands becomes available, an increasing number of IDE drive vendors will certainly be including support for these commands.

The ROM BIOS in an AT system has a drive table that includes the drive parameters for all hard disk drive types supported by the BIOS. The parameters for each drive type in the table include number of cylinders, number of read/write heads, number of sectors per track, and write-precompensation (if any). The majority of the traditional AT ST506 drives employ MFM encoding, which corresponds to 17 sectors per track; therefore, most AT drive-table entries specify 17 sectors per track. Most newer drives employ RLL encoding, corresponding to 26 sectors per track, so the drive table in most AT BIOSes now includes at least several entries for 26-sector-per-track drives.

Existing AT BIOSes do not normally have drive-type entries with the 34 or more sectors per track common to most IDE drives. In the past, this sector density has been traditionally reserved for SCSI and ESDI drives. Since one of the primary goals of IDE was to allow proper operation with existing AT BIOSes, these drives take advantage of their intelligence and make themselves look different than they really are.

For example, the CP3044 drive from Conner Peripherals has 1047 cylinders, two heads, and 40 sectors per track. Even with a custom drive-table entry in an AT BIOS, this configuration could not be supported, since the BIOS can only handle a maximum of 1024 cylinders. The CP3044 drive, however, operates in a *translate mode* that makes the drive appear to have 980 cylinders, five heads, and 17 sectors per track. Note that the number of sectors is nearly the same ($1047 \times 2 \times 40 = 83{,}760$ sectors, compared to $980 \times 5 \times 17 = 83{,}300$ sectors), so the total drive capacity is effectively unchanged.

Most drives have an equal number of sectors on every track. However, since the platters rotate at a constant speed, data is stored more densely on the tracks closest to the spindle. That makes the data density of the innermost track the limiting factor in storing data on the platters. For greater capacity, some IDE drives take advantage of *zone recording*, in which an attempt is made to keep the linear density of the stored data fairly constant so the tracks (or cylinders) are divided into zones.

For example, the Quantum ProDrive LPS 52AT drive has three recording

HARD DISK DRIVE REGISTER DEFINITIONS

Table 2: *For compatibility with the standard ST506 controller, chip selects are active in the 1F0-to-1F7 and 3F0-to-3F7 I/O-addressing ranges (N/A = not applicable).*

I/O address	Read register	Write register	Hard or floppy?
1F0	Data register	Data register	Hard
1F1	Error register	Write precomp	Hard
1F2	Sector count	Sector count	Hard
1F3	Sector number	Sector number	Hard
1F4	Cylinder low	Cylinder low	Hard
1F5	Cylinder high	Cylinder high	Hard
1F6	Drive/head	Drive/head	Hard
1F7	Status register	Command register	Hard
3F2	N/A	Digital output	Floppy
3F4	Main status	Main status	Floppy
3F5	Diskette data	Diskette data	Floppy
3F6	N/A	Fixed disk	Hard
3F7	Digital input	Diskette control	Hard/floppy*

Notes:
* The digital-input register includes 7 bits for the hard disk and one for the floppy disk.
All I/O addresses are in hexadecimal.

zones. Zone 0 has 49 sectors per track, zone 1 has 42, and zone 2 has 35. Such a configuration would be impossible to specify in a standard AT BIOS drive table, but an IDE drive can operate in its translate mode and appear to the system as a standard AT drive with 17 sectors per track on all cylinders. The translation for the Quantum drive is 751 cylinders, eight heads, and 17 sectors per track.

IDE drives vary in how they handle the logical-to-physical sector translation. Most support only fixed translation, in which the drive's logical (AT) configuration must be used only as specified. Other drives offer variable translation, where any entry in the AT BIOS's drive table can be used as long as the total number of sectors in the chosen drive type does not exceed the total number of physical sectors on the IDE drive. Because any precompensation that may be needed is handled internally, IDE drives *ignore* the precompensation value in the AT BIOS drive table.

IDE COMMANDS

Table 3: *Mandatory commands are those supported by the original IBM AT ST506 controller. When BIOS support for optional commands, such as* `Read Multiple` *and* `Write Multiple`*, materializes, drive vendors will be able to support IDE's advanced capabilities. All command codes are in hexadecimal; N/A = not applicable.*

Command	Class	Command code	Optional?
Check Power Mode	1	98 E5	Yes
Execute Drive Diagnostic	1	90	No
Format Track	2	50	No
Identify Drive	1	EC	Yes
Idle	1	97 E3	Yes
Idle Immediate	1	95 E1	Yes
Initialize Drive Parameters	1	91	No
Recalibrate	1	1x	No
Read Buffer	1	E4	Yes
Read DMA (with retry)	1	C8	Yes
Read DMA (without retry)	1	C9	Yes
Read Multiple	1	C4	Yes
Read Sector(s) (with retry)	1	20	No
Read Sector(s) (without retry)	1	21	No
Read Long (with retry)	1	22	No
Read Long (without retry)	1	23	No
Read Verify Sector(s) (with retry)	1	40	No
Read Verify Sector(s) (without retry)	1	41	No
Seek	1	7x	No
Set Features	1	EF	Yes
Set Multiple Mode	1	C6	Yes
Set Sleep Mode	1	99 E6	Yes
Standby	1	96 E2	Yes
Standby Immediate	1	94 E0	Yes
Write Buffer	2	E8	Yes
Write DMA (with retry)	3	CA	Yes
Write DMA (without retry)	3	CB	Yes
Write Multiple	3	C5	Yes
Write Same	3	E9	Yes
Write Sector(s) (with retry)	2	30	No
Write Sector(s) (without retry)	2	31	No
Write Sector(s) (with retry)	2	32	No
Write Sector(s) (without retry)	2	33	No
Write Verify	3	3C	Yes
Vendor unique	N/A	9A	N/A
Vendor unique	N/A	C0-C3	N/A
Vendor unique	N/A	8x	N/A
Vendor unique	N/A	F5-FF	N/A
Reserved: all remaining codes			

Other IDE Advantages

In addition to the many advantages that I have already described, IDE drives shine in other areas as well. A large number of IDE drives include a special feature called *automatic bad-sector remapping*, which helps ensure long-term reliability. These drives have spare sectors that are reserved for future use. When the drive detects a sector-read error several times in succession, the data is recovered (using the Reed-Solomon error-correction code that is stored with the sector) and stored in one of the spare sectors. The bad sector is then tagged as unusable, and the new sector is put into the drive's lookup table as the replacement for the bad sector.

IDE drives generally have power-consumption advantages over other drives. A large majority of IDE drives are of the 3½-inch form factor and are often used in applications where minimal power consumption is desirable. As the trend continues toward increased usage of 2½-inch drives and low-profile (1-inch-high) 3½-inch drives, even more emphasis is being placed on using very-low-power components on these drives. The current draft proposal includes commands to place the drive in one of four power conditions: Active, Idle, Standby, and Sleep, in order of diminishing power consumption. When implemented, this will be especially important for battery-operated laptop computers.

The Dark Side of the Force

While my description of IDE up to this point has been glowing—and justifiably so—there are, inevitably, some drawbacks. The most obvious one is the lack of standardization. With the introduction of the draft proposal and the current standardization efforts, however, the incompatibilities that have surfaced in varying implementations should gradually disappear.

As anyone who has been around the PC industry for a while can attest, 100 percent compatibility is a very difficult and elusive goal. This is no less true with IDE. While every attempt has been made to make IDE drives look like standard AT ST506 drives to an AT, the implementation of this facade has not always

been perfect, even though the registers look the same and the commands work identically. Subtleties sometimes creep in and spoil everything.

In one case, for example, a company's employees were happily using a 100-megabyte IDE hard disk drive on their 386-based DOS system. They subsequently installed an IBM Token Ring network, a Qualitas 386Max driver, and a custom application program. This configuration had run successfully in the past with a standard ST506 drive, but occasional data-read errors started occurring when running with the IDE drive. Replacing the drive with another of the same type did not fix the problem.

It turned out that 386Max and the IDE drive did not get along very well. When 386Max switched into protected mode, the drive could not respond fast enough to commands. Ironically, an earlier release of 386Max worked fine, as did the similar QEMM-386 driver from Quarterdeck. An IDE drive from a different manufacturer worked successfully in the application and solved the problem; its internal timing was just different enough to matter. These kinds of anomalies will likely go away as the IDE drive market matures.

IDE drives also differ from standard ST506 drives when it comes to traditional hard disk utilities. For example, IDE drives are low-level-formatted at the factory, and you cannot employ any low-level-format utility to reformat the drive. Remember, the IDE drive has only a logical appearance to the AT, so a standard low-level-format utility could not work correctly.

Similarly, other utilities that attempt to modify the drive's sector interleave to determine the best performance point will not work. Virtually all IDE drives are configured for a 1-to-1 interleave internally, and they don't support interleave changes. Even drive-performance benchmark utilities will not be completely accurate. For example, when measuring seek time or head-select time, only the logical heads are "moving," and the actual physical movement of the drive's heads will be much less (perhaps one-fourth as much).

IDE is rapidly becoming the dominant hard disk drive interface in the AT marketplace, and for some very good reasons. It offers manufacturers and users a "win-win" drive alternative. IDE drives are less expensive than their controller/drive combo counterparts, yet they offer more flexibility, better functionality, AT compatibility, faster speed, and easier implementation. Better yet, the ATA interface specification is now well on its way to official ANSI standardization. IDE drives are now available with capacities of up to 300 MB, and even larger disks loom on the horizon. Odds are that there's an IDE hard disk drive in your future. ■

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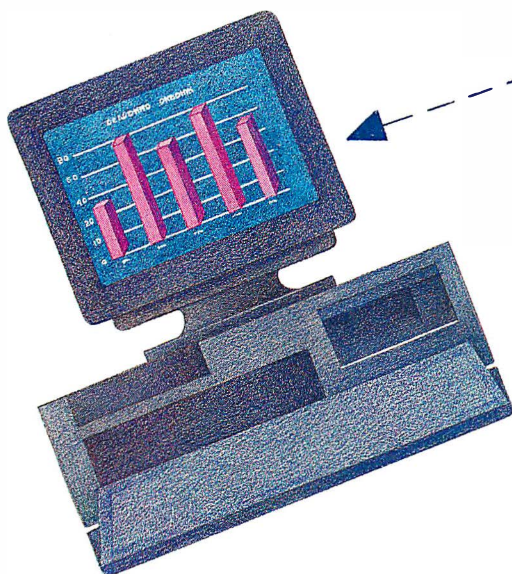
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Windows Programming Made Easy

Martin Heller



You don't need C to automate the Windows environment

I was first going to call this particular column "End-User Programming in Windows." But after I got into the subject, I realized that the question of who is an end user has many answers. We haven't gotten to the point where the average secretary can integrate half-a-dozen Windows programs; but a beginning BASIC programmer might do fine. You just need a few programming concepts and the patience to read manuals.

Integration Tools

Some simple integration tools are built into Windows: the Program Manager, the WIN.INI file, and the Recorder. You can download other tools from BIX and buy many more. But I'll start with what you already have. (If you're not at your computer now, you might want to go there later and try out some of this.)

Take a look at your WIN.INI file. The simplest way to do this is to run SYSEDIT. If you don't already have SYSEDIT in one of your Program Manager groups, add it now: Pull down FILE/NEW, click on OK, tab once, and type SYSEDIT in the command-line edit control of the Program Item Properties dialog box. Click on OK, and you should see the SYSEDIT icon in the group you selected. Now, double-click on the SYSEDIT icon. It will open four files: CONFIG.SYS, AUTOEXEC.BAT, WIN.INI, and SYSTEM.INI. Click on WIN.INI to bring its editing window to the top. You'll see something like the following:

```
[windows]
load=saver winexit
timelin3
run=
Beep=yes
Spooler=no
NullPort=None
```

You may see different things to the right of the equal signs, but the keywords to the left of the equal signs should be the same. The `load=` line determines what programs should automatically be run as icons when Windows starts; the `run=` line determines what programs should be automatically run as windows when Windows starts. I start every Windows session with a screen saver, an icon that helps me leave Windows quickly, and a time-and-date display. You can download all three of these utilities from the "microsoft listings" area on BIX.

I don't list any programs on the `run=` line because I don't always run the same programs. But if I were using Windows primarily for word processing and spreadsheets, I might list something like `run=winword excel`. You can even list COMMAND.COM on the `run=` line, if you always want to start a DOS session within Windows. However, the `run=` and `load=` lines work only at the beginning of your Windows session, just as your AUTOEXEC.BAT file works only at the beginning of your DOS session.

You can automate things you do during a Windows session using the Recorder; you will find the Recorder icon (a camcorder) in the Accessories program group. Recorder can watch your mouse-clicks and key presses and play them back on demand (and even assign scripts to function keys); it's useful for speeding up all sorts of repetitive tasks and for building your own demonstration and testing scripts.

Softbridge

Softbridge developed the Recorder for Microsoft, and, as

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you might expect, it has a big brother you can buy directly from Softbridge. Actually, it has two big brothers: Bridge Batch and Bridge Tool Kit. Bridge Batch ($179) gives you a batch language for Windows, a dialog box and batch file editor, and a recorder that integrates with the batch language. You can integrate an entire workstation with Bridge Batch, as long as you don't need to include DOS programs in the mix.

If you do need to integrate DOS and Windows programs, Bridge Tool Kit ($695) adds the capability to feed keystrokes to DOS programs, pass messages between DOS and Windows programs, and send messages over a LAN. For one-off integration jobs, this is just what the doctor ordered, although the Bridge run-time royalty structure might discourage integrators with more than a few clients for a given job.

The concept of a batch language for Windows has received more than a little attention recently. Beyond the control structures (e.g., IF...THEN clauses), variables, and means to pass commands to the environment that you need in a DOS batch language, a Windows batch language has to be able to create windows, message boxes, and dialog boxes. To be really useful, it also needs to support Dynamic Data Exchange (DDE). Bridge Batch does all this, as does Asymetrix's ToolBook. For that matter, so do the Excel and Word for Windows macro languages.

ToolBook

The Bridge batch language looks much like BASIC (see listing 1). ToolBook's OpenScript language looks more like structured English (see listing 2). You can find out more about ToolBook quickly by taking the "Tour" that comes with Windows and playing with the DayBook application.

Don't be put off too much by the lack of speed in the ToolBook demonstrations: These applications use huge, colored bit maps that slow them down terribly. And, of course, ToolBook will be faster Real Soon Now.

ToolBook can be programmed by recording your keystrokes and mouse-clicks, just like the Recorder. You can then edit the ToolBook code, adding control structures and deleting extraneous commands. This approach is a big time-saver compared to writing all the code by hand.

Microsoft's Approach

Word for Windows 3.0 takes the same approach: You can automate almost any Word for Windows operation by recording a macro, and then you can edit the macro to your heart's content. Actually, macro is a misnomer here. Word for Windows' (and Word for Presentation Manager's) language, WordBASIC, is much more than a macro language: It is a full-blown structured BASIC interpreter with a syntax like QuickBASIC, a complete set of word processing primitives, an integrated debugger, and a full set of commands to control other applications (see listing 3).

If you have Word for Windows and know a little BASIC, you can use WordBASIC to integrate almost your entire Windows desktop—you don't even need Bridge Batch or ToolBook for about 80 percent of what you'd want to do. You don't need to write C programs, either. You do need to understand how to use all the programs you want to integrate, and you need to understand DDE.

This is not to say that you won't have to do any programming. You'll do a lot of programming. But it will be in BASIC, and you'll be able to do a lot of it by pointing and clicking. This is not speculation: A big law firm in Seattle has all its document handling automated on a LAN with Word for Windows, some custom WordBASIC, and a handful of other Windows applications. The users think they are using Word all the time; in reality, many applications are active, all communicating with DDE and controlled from Word.

There are a few problems learning to write WordBASIC right now. The silliest one is that the Word for Windows technical reference is not supplied with the rest of the product; it's a fulfillment item for an additional $25. It isn't all that good once you get it, either—not much of an improvement over the TECHREF.DOC file that is supplied with Word. There's no dialog box editor, so you have to program your dialog boxes, guessing about dimensions and correcting them after you have seen the dialog box on the screen. And there isn't much in the way of examples to look at—just a few programs in the file EXAMPLES.DOC.

Microsoft didn't get where it is today by making things difficult for programmers. I've had a look at the new, improved Microsoft Word for Windows and Presentation Manager technical reference, and it's all that a moderately experienced BASIC programmer could want for learning WordBASIC.

An additional manual written for Microsoft by Wextech Systems, Using WordBASIC,

Listing 1: *Bridge Batch provides a mixture of traditional and Windows-specific script capabilities.*

```
REM Example Bridge DDE script
REM Make Bridge small and start Excel
MINIMIZE;
WARNING OFF; EXEC /n:excel excel;
MOVE 8 12 90 80
IF %error% PAUSE "Microsoft Excel did not start";
  RETURN
REM Tell Excel to connect DDE commands to "sheet1".
REM Sheet1 is the default empty spreadsheet when Excel
  starts.
x = DDE.INITIATE(DDEexcel, excel, sheet1)
IF %x% GOSUB ErrReturn "dde.initiate failed: (%x%)"
<other commands>
:ErrReturn
GOSUB ShowMsg %1
IF APP.EXIST(excel) SELECT excel; CLOSE
EXIT
```

Listing 2: *HyperTalk programmers will feel right at home with ToolBook's OpenScript.*

```
- You will need to assign a value to pClipField. One
- of the best ways of getting that value is to select
- a field and get its uniqueName.

to handle COPYSCRIPTTOCLIPBOARD fScriptID
  set text of (pClipField of this book) to script of
    fScriptID
  set sysLockScreen to true
  send Background
  select text of pClipField of this book
  send cut
  send foreground
  set sysLockScreen to false
end
```

Listing 3: *WordBASIC is a full-fledged language that can control Word's editing primitives and Windows' user-interface objects.*

```
Sub MAIN
Marker$ = "@"
IndentSpaces = 5 'spaces marking a new paragraph
A$ = "5"
A$ = InputBox$("How many spaces mark a new paragraph?
  [default 5] ",\
"Define Paragraph", a$)

'if the user typed a digit, use it
If Val(A$) <> 0  Then IndentSpaces = Val(a$)

'create the string of spaces
Spaces$ = String$(IndentSpaces, Chr$(32))

'go to start of document
StartOfDocument

'Replace all hard carriage returns with Marker$
EditReplace .Search = "^p", .Replace = Marker$,
  .WholeWord = 0, \
.MatchCase = 0, .Confirm = 0, .Format = 0

'Replace single Marker$ followed by Tab with hard
  carriage return
EditReplace .Search = Marker$ + "^t", .Replace = "^p",
  .WholeWord = 1, \
.MatchCase = 0, .Confirm = 0, .Format = 0

'Replace single Marker$ followed by IndentSpaces with
  hard carriage return
EditReplace .Search = Marker$ + Spaces$, .Replace =
  "^p", .WholeWord = 1, \
.MatchCase = 0, .Confirm = 0, .Format = 0

'Replace hard carriage return pairs with a single hard
  carriage return
EditReplace .Search = Marker$ + Marker$, .Replace =
  "^p", .WholeWord = 0, \
.MatchCase = 0, .Confirm = 0, .Format = 0

'Replace all remaining hard carriage returns with a
  space
EditReplace .Search = Marker$, .Replace = " ",
  .WholeWord = 0, \
.MatchCase = 0, .Confirm = 0, .Format = 0
End Sub
```

nicely bridges the gap between the Word user's reference and the Word technical reference, and it comes with some (documented!) sample WordBASIC programs. One of the goodies in here is a set of macros for translating Excel dialog boxes into Word dialog boxes—and a copy of the Excel dialog box editor. This isn't as nice as having a real dialog box editor for Word, but it works.

Microsoft has put together the rest of the needed materials, too. There's a little on-line reference called the WordBASIC Advisor, a collection of macros to integrate various Windows programs (at this writing, WordScan, DaVinci E-mail, MathType, PackRat, and Superbase) with Word, and several useful examples (e.g., a set of macros to convert vowels to their accented forms). When this will be debugged and generally available, I can't say—maybe by the time you read this article.

What's Ahead

The next step in integrating Windows applications is a little further out on the horizon: embedding and linking, or Extensible Compound Document Architecture (ECDA). Windows documents now can have hot links to other programs using DDE, but there is no standard way of using DDE. Every application has its own unique macro language and its own meaning for "data item." The embedding-and-linking specification adds a standard list of topics for DDE conversations and standard ways for applications to implement actions such as inserting a new object (e.g., an Excel graph) into a container (e.g., a Word document).

The ECDA technology has been implemented once already: Microsoft's PowerPoint does its charting using an external application. PowerPoint and its graph module communicate with embedding and linking. ECDA promises to make the integration of applications even easier for the end user—at the cost of more work for Windows application developers. ■

COMPANIES MENTIONED

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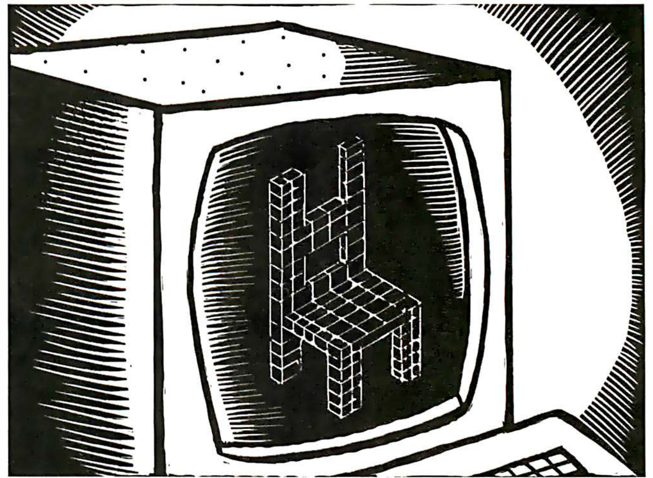
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MACINATIONS

The Business Macintosh

Don Crabb



A good deal of ink has been spilled in the past year about whether the Macintosh is really a business computer. Complaints about its software standards, operating-system proclivities, and networking prowess have showered in, mostly from the usual suspects. Mac detractors complained ad nauseam about its graphical user interface getting in the way of power users. Fortunately, most of this carping has finally died because, in a supreme irony, Microsoft validated the Mac's GUI with its own Windows 3.0 for PCs.

Amid all this journalistic carnage, an interesting software trend has emerged on the Mac: simulation and modeling systems. As it has done with desktop publishing, desktop presentations, desktop communications, and desktop multimedia, the Mac has "desktopped" yet another important category of business software—the desktop simulator. The Mac makes a nearly ideal simulation/modeling engine, at least in its more robust configurations (i.e., a color Mac IIcx or better), because of its blend of a well-established GUI, good floating-point performance, and an impressive color display for simulation animations.

Simulation and modeling has grown slowly on the Mac (and hardly at all on non-Mac platforms) because it's a highly technical subject that is often difficult to learn and master. However, new products are breaking down those learning and usage barriers and making the underlying mathematics of simulations (i.e., ordinary and partial differential equations [ODE/PDE]) more accessible.

New versions of Extend, an object-oriented program from Imagine That (San Jose, CA), and I Think, a powerful business desktop simulator from High Performance Systems (Hanover, NH), have given these subjects a big boost. (I'll talk about I Think later in this article.) Just as Multiplan and Excel introduced Mac business users to the goal-seeking and what-if possibilities of automatically updated (if static) financial models, Extend and I Think are introducing those same users to the power of dynamic models and simulation systems.

A year from now, I expect managers to search for solutions by using these desktop simulators to model their business problems. A fully animated desktop model, which uses visuals and sound to show how a business works and displays dynamic I/O over time, will be highly instructive. Several years from now, these same managers will wonder how they ever got along without desktop simulations—just the way they think of spreadsheets today.

I expect several large software houses to enter the desktop simulator market over the next year, which will validate

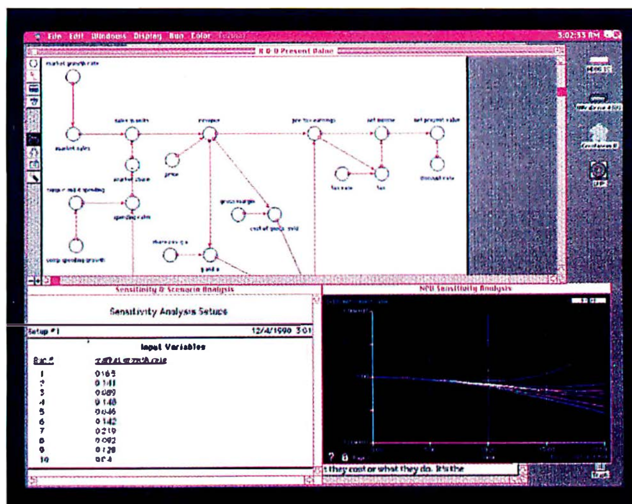
Modeling and simulation promises to be a hot new category of business software for the Macintosh

this growing category of software yet again. You should also expect to find that some enterprising developers will wed the systems-modeling capabilities of desktop simulators to project management applications such as Project Scheduler 4 and MacProject II. This will produce hot new hybrid applications that will be able to simulate complex business projects and create suggested plans and schedules

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He is the author of a new book, Using Filemaker Pro *(Simon & Schuster/Brady Books). He is also a contributing editor for BYTE. He can be reached on BIX as "decrabb."*

for implementing them. That is the kind of "intelligent computing agent" that Apple has been talking about for a couple of years now, and it's likely to make an appearance by late this year.

Of course, if interapplication communication is everything that Apple cracks it up to be, such hybrid applications should be easy to implement once a data structure for representing a dynamic model is agreed upon. Like most advances in personal computing over the last 20 years, the big breakthrough will come when a widely accepted modeling file structure is adopted.



I Think running a business simulation.

Software of the Month: I Think

Stella 2.10, from High Performance Systems, was a first-rate business simulation/modeling program for the Mac. I Think is much more than an upgrade of Stella 2.10: It has been entirely rewritten. An educational version that includes scientific-modeling capabilities is available as Stella II. I Think takes Stella and extends its capabilities in many areas, especially in how models are animated and graphics are incorporated. It also provides numerous extensions to the ODE. I Think, however, is a business tool, designed from its first line of code to let you create business and financial models and create output that you can use for its predictive as well as analytic prowess.

I Think uses three simulation algorithms: Euler's method, second-order Runge-Kutta, and fourth-order Runge-Kutta (see "The Runge-Kutta Methods," April 1986 BYTE). You can also select the appropriate step size and the integration method used for each I Think model that you create. It even includes the documentation that lets you translate a system of ordinary differential equations into an I Think model. In short, I Think is sort of a visual thinking tool that can model business processes, letting you test plans and scenarios on your Mac before you commit money and resources to a real project.

I Think is a discrete systems simulator that takes the idea of what-if analysis pioneered by spreadsheets and makes it both dynamic and visual. It lets you visualize the relationships between events, outcomes, and inputs in a way that is simply not possible with a spreadsheet table of numbers. Because I Think always displays the dynamic picture of your model, you can see how each process contributes to the overall success or failure of your plan. Unlike a spreadsheet, where you spend a lot of time analyzing the numerical output of your efforts, I Think lets you concentrate on the processes creating that output.

The screen shot gives you some idea of I Think's orientation. It shows three I Think windows: the diagram, the input variables, and an output graph. The diagram window is where you create your I Think simulation, using symbols to represent different kinds of simulation variables and outcomes. Arrows indicate the flow within the model. You can explode each node by double-clicking to add data to it or to modify its behavior and time constraints.

Input variables can be listed in tables like those in the screen, where they can be altered quickly. Graphical output, shown here as a line chart, can also be customized to help reveal the important operational peculiarities of your model. I Think also lets you exchange your model data with other Mac software for further analysis, and you can incorporate Paint or PICT images as part of your model diagram, as well as sounds.

What is I Think good for? A better question would be, what isn't it good for? Just about any business situation or project can be modeled using I Think, and you can gather valuable model output long before you commit to the real scenario that your model suggests. I Think gives you a real what-if planning tool that takes into account the dynamic and visual nature of most business processes (and scientific ones with its Stella II incarnation).

Tip of the Month: HandOff II

The Mac can be a pretty inhospitable place to work sometimes, especially when you've come up against one of my favorite warnings: "Application Not Found. The application is busy or missing." Which translates into, "You lose." Rather than putting your fist through your monitor (a costly but perfectly satisfying response) when that alert pops up, try to keep your hands off the problem, using HandOff II from Fred Hollander's HandOff Corp.

HandOff II lets you assign applications to open files that you do not have the original applications for. Naturally, this won't help if you are trying to open a 4th Dimension file with SuperPaint, but it works well when you want to open old MacWrite 4.5 files with MacWrite II or Nisus 3.01, or open old Multiplan files with Excel. As long as the application you specify can read the file format, you're in business. The beauty of HandOff II is that you make this correspondence between the existing application and file creator only once. After that, HandOff II intercepts the file type and opens it with the designated application. You can also interrupt this feature whenever you want, in case you have acquired the necessary program.

HandOff II includes a lot of

ITEMS DISCUSSED

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I Think 1.0............$450
Stella II................$450
High Performance Systems, Inc.
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other goodies, such as a pop-up menu for launching applications (à la On Cue), the ability to control the color depth and sound level of each application you launch, and automatic fixing of bundle bit anomalies. There's also support for the Desktop Manager (which fixes the Finder's problems with large hard disks full of files and folders).

If HandOff II still won't solve your problems because of file incompatibilities, you can try Abbott Systems' CanOpener (which can open virtually any file type—text, Paint, or PICT) or On Technology's On Location for a glimpse inside a recalcitrant file. ■

THE UNIX /bin

Tricks of the Unix Gurus

David Fiedler

Sometimes the obvious isn't. One person's challenge can be another's frustration. This month, I've decided to provide a couple of hints that I've found useful in the past. Some of these may seem simple to advanced readers, but they have saved many people a great deal of time and trouble in a pinch. On the other hand, they may just be thought-provoking enough to help you solve a problem that you've already been working on—perhaps a different type of thing altogether.



Tips on disaster recovery, logging calls, and getting rid of garbage files

More Than One Way to Replace a Cat

On some Unix implementations, a crashed root file system disk or inadvertent loss of the executable kernel (that file called /unix) means you're in for a long, backbreaking session of reloading much of the system. Hopefully, you also have good backups of your own files, too.

SCO Unix and Xenix systems give you the option of creating a custom "emergency boot floppy." This lets you boot up your system with one or two floppy disks and access information that's still on your hard disk drive. Frequently, you can easily restore your system via tape or fsck manipulations if you've gone to the trouble of creating the bootable floppy disk.

But the limited amount of space on these floppy disks means that few commands can fit on them. In fact, such commands as cat and cp are installed only if there's extra room available (some disk installations don't even have ls). You would be amazed how important these commands are when you *don't* have them readily to hand. So what can you do in such a situation (or in any emergency situation where basic commands are missing)?

The important thing is to keep calm and remember the basics. Many Unix commands have more than one method of operation. In the case of the missing ls, you could type

```
# echo *
```

while in a directory (echo is usually built into the shell). If cp isn't there, you'll probably have dd available, and you can always use

```
# dd if=onefile
of=another
```

And even if cat is missing, you can still look at things with dd:

```
# dd if=file
of=/dev/tty
```

Don't forget redirection. If you have to look at a critical file under these conditions (or if your entire printer spooler has gone crazy), you can always print files by simply copying them to the right device. The following are all equivalent:

```
# cat file > /dev/tty1a
# cp file /dev/tty1a
# dd if=file
of=/dev/tty1a
```

assuming, of course, that your printer is plugged into port /dev/tty1a.

Logging a Communications Session

Want to keep a log file of a modem call to another system but don't have any optional communications software that does this for you? Use the plain old cu program but with a twist:

```
$ cu | tee logfile
```

and everything should be saved just fine. You can often use this technique with other programs; it even works for capturing the output of several seconds' worth of screen-oriented programs like stars or worms, which can then be mailed to innocent coworkers (you should be sure to set your terminal environment to match theirs before you run the program).

Getting Rid of Those Unwanted Pests

It's not extermination of vermin or even murder I'm talking about here, but files. The kinds of files that you created by a slip of the finger, or by a test program that created a filename from uninitialized memory. The kinds of files whose names are -foo or *f5jx, or that are composed of control characters so that you couldn't type them even if you wanted to (and you *do* want to, very much). How can you get rid of them?

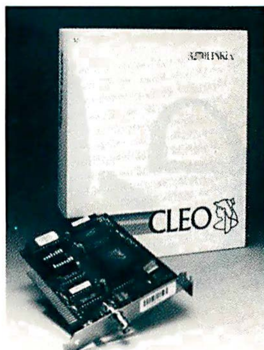
Users of recent releases of Unix don't have the hyphen problem. There's a new option to the rm command that

---

David Fiedler is executive producer of Unix Video Quarterly *and coauthor of the book* Unix System Administration. *He has helped start several Unix-related publications. You can reach him on BIX as "fiedler."*

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allows filenames to begin with a hyphen; the option is a double hyphen. Therefore, typing

```
$ rm -- -foo
```

will properly delete a file called -foo. Without this modification, the rm command sees the hyphen as an option lead-in, rather than a filename. There are several classic ways of getting around this problem, some of which work on various systems and fail on others. For hyphens, you can type rm ./-foo, using the dot and slash to *hide* the hyphen from the rm command. You can also type

```
$ mv -foo foo
$ rm foo
```

on some systems where the mv command itself has no options. Or you can try the /etc/unlink command, which also has no options. If your filename starts with an asterisk, where a mistake could cost you all the files in your directory, be more careful when you type the rm command:

```
$ rm -i \*f5jx
*f5jx: ? y
$
```

In this case, the preceding slash again *hides* the asterisk from the shell, preventing it from expanding the asterisk into its usual meaning of "all filenames in this directory not preceded by a dot." The -i (interactive) option to rm forces it to prompt you for every file that it intends to remove, which gives you a chance to correct any possible mistakes at the last moment. In this case, your answer of y means yes, remove the file.

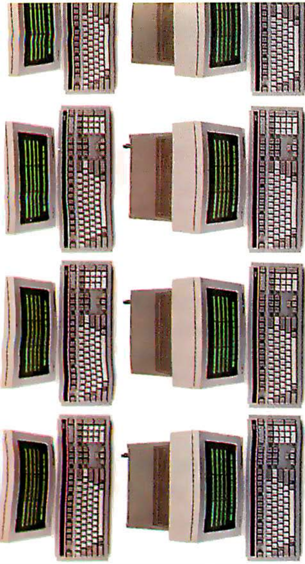
Is your system haunted? Do you hear bells every time you type ls? You've probably got a Control-G in a filename! For really hard-to-type filenames (ones that contain such fun characters as octal 206 and the like), you'll soon find out about the -b option to the ls command. But let the system do the work for you. Simply capture the filename by ls -al > /tmp/foo and then edit /tmp/foo to remove all filenames *other* than the one you're interested in. Then just add an rm before your funny filename, return to the shell, and execute sh /tmp/foo to remove your pesky file.

As long as I'm discussing eighth-bit characters, I recommend getting a copy of fm (File Modifier) by Tony Field and D. Jason Penney. It's a hexadecimal/ASCII file editor with an excellent user interface (better than that of some commercial programs), and it's available under the GNU licensing terms (i.e., free). With fm, you can save the day by patching binary files that otherwise couldn't be modified. It won't work on directories, although a real diehard could use it on the raw disk.

You Deserve a Break Today

Everyone's entitled to a little fun. Heck, after slaving away all day over a hot terminal, surrounded by awking greps, you have probably earned a *lot* of fun. Unix, while clearly a serious operating system for commercial uses, also has its fun side. After all, Unix got started when Ken Thompson was looking for a machine to run a Space War game on, and the /usr/games directory has been a popular one ever since. One trick of the Unix gurus is to relax once in a while.

Don't get me wrong; I'm

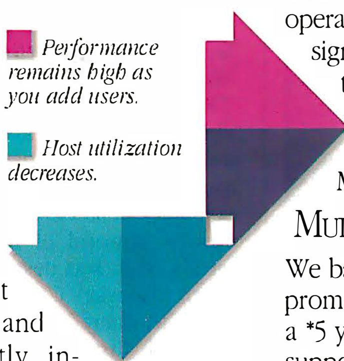


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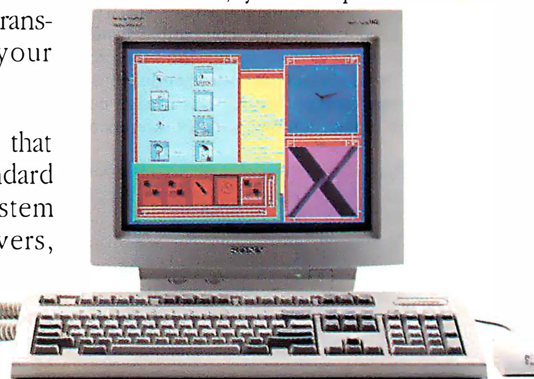
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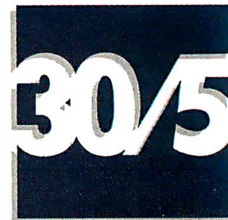
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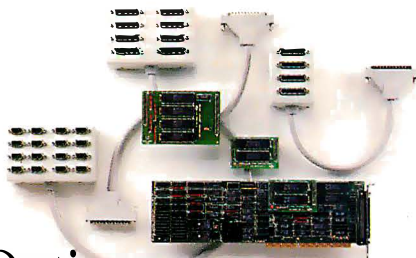
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certainly not encouraging anyone to play games on company time. But between Thompson's creation of Unix and his passion for computer chess, it's clear that seemingly frivolous pursuits can have quite serious applications. After all, what is Adventure but an attempt to anticipate the exact keystrokes of a user? Call it context-sensitive programming at its best.

A Real Adventure

Adventure was originally written by Crowther and Woods, I believe, in FORTRAN, for a large DEC machine. It quickly attained legendary status and spread around college campuses and computer centers. Adventure created a world of its own, purely from text descriptions about Colossal Cave. Compared to many of the games originally distributed on Unix (e.g., the forgettable "wumpus"), Adventure shows imagination in its writing and requires quite a bit to get through it. And remember, Adventure was one of the first Unix games to automatically turn itself off during prime time or whenever the system got too busy.

David Betz wrote what you might call an "adventure construction kit" called `advsys`, which is essentially a special-purpose language and compiler. Like most of the programs mentioned in this column, `advsys` was posted to Usenet and is available from any of several on-line archive sites that have been mentioned in past columns.

Maybe one of you enterprising readers should get hold of a copy of `advsys` and make a parody Unix adventure. "You are in a maze of twisty little directories, all different" and "I see no makefiles here" are just some of the hilarious gag lines we could expect from this effort.

What Is Going On Here?

After playing Adventure for a while, the predictability and endless passageways sometimes get to you, and you begin wanting something that involves a lot more action. Rogue, written by Ken Arnold and Michael Toy at the University of California at Berkeley (the version I have is dated 1981), leads you down through the Dungeons of Doom as you attempt to retrieve the Amulet of Yendor, while fighting off beastly critters the whole way.

And Rogue was the first Unix game to use graphics. Even though all the goblins and dragons and things are merely uppercase and lowercase characters, you move through a maze that is actually drawn on the screen. The maze changes every time you play it, so it's impossible to get bored by the same old paths. You move your character around while picking up scrolls and potions and try to defeat monsters by running into them.

(By the way, these programs are addictive. You have been warned. Neither I nor the BYTE editorial staff is responsible for lost sleep, waste of CPU cycles, late projects, or divorces, actual or threatened.)

No Easy Way

There's no one place you can go to find all this software (except perhaps `uunet`), so some exploring of the networks, archives, and dial-up Unix systems is in store for you. But as they say in Adventure, "If you think you have found all the treasures, just keep exploring for a while." And that—aside from trying to compile the stuff and playing with it once you're done—is half the fun.

Next Month

If you've been running your system for a while, you have probably made modifications that can complicate some tasks, such as getting new users up and running. I will provide some tips that should make life easier. ■



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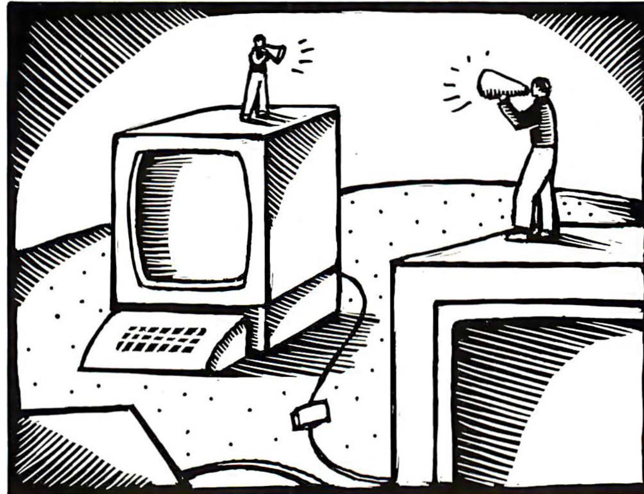
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NETWORKS

In Praise of Remote Procedure Calls

Barry Nance



RPCs let you develop a single application that runs concurrently on IBM, DEC, Sun, and Apple computers

Remote procedure calls are the tools of choice for building client/server systems. They're magic glue that lets programmers treat a heterogeneous network of computers as if they were one big computer. You use RPCs to target each part of an application to the type of computer for which it's best suited, be it a Macintosh, a 486 system, or a Sun workstation.

Here's an example. A program begins life on a Mac, gathering data from one of the people on the network. The Mac program calls a subroutine on an i486-based system when it needs to perform some complex, lengthy calculation. (The call statement in the Mac source code looks like any other subroutine call.) After program control and the calculation results are returned to the Mac, the program updates a database by calling another subroutine—located on a VAX minicomputer. (Again, you couldn't tell by looking at the program statements that the database update module is running on a VAX.)

Build Your Own

What do you have to do to use RPCs? You code each module in C, designating each program module as either a server or a client. The server module is the back-end application; it performs calculations, generates reports, and stores permanent database records. The client module manages the front-end user interface.

You create an RPC compiler script that identifies the server and client modules, and then run the RPC compiler to generate the C source code that glues the modules together as one executable program. Underneath, the generated code creates a communication session between the client and server modules. But the client code calls the server modules in the same way that it might call any other subroutines. The fact that the client and server modules execute on different computers becomes mostly transparent to the application.

When an application makes a subroutine call to a program module on a different computer, the RPC-generated code creates a new communications session between the computers or uses an existing session. The subroutine call becomes a send operation and, on completion, a receive. The generated program code for each subroutine consists of a stub with the same name as the remote subroutine. The stub manages the communications session with the actual code module on the remote computer. An RPC itself consists of a network-specific library of LAN communication services and the RPC compiler for generating the C source code glue.

The figure shows an RPC in action. When the program calls the `calc_results()` subroutine, it's actually invoking a local stub routine written by the RPC compiler. This client stub uses the communications session with the server stub to invoke the real `calc_results()` routine on the remote server. The client then sends data, in the form of passed parameters or global data items, to the server computer, where the `calc_results()` module processes it. When the remote routine completes, it sends the results back to the originating computer. The data looks as if `calc_results()` had executed on the local machine.

The Proprietary Problem

Distributed client/server processing is nothing new. Xerox first developed it at the Palo Alto Research Center at about the same time it developed windows and the mouse. Sun Microsystems later created the first commercial instance of RPCs on top of its Network File System. RPC tools are now available from many companies, including Hewlett-Packard, Sun, Netwise, and Novell (Novell's RPC is a repackaged version of the Netwise RPC Tool for SPX).

On an OS/2-based LAN, named pipes is the medium for connecting two parts of an application. On a NetWare LAN, RPCs use the SPX protocol to invoke remote functions. Other networks use TCP/IP, DECnet, NetBIOS, or even IBM's LU 6.2. Netwise covers all these bases; other companies limit their RPC implementation to the transport layer used by their proprietary networks. Until the LAN industry achieves transport independence, you must be careful about whose RPC product you choose. You could wind up with less connectivity than you planned for.

Different computers represent data differently. An RPC handles these internal representations by packing and unpacking the data into protocol data units, or PDUs. Once packed, the contents conform to the ISO's Specification of Basic Encoding Rules for Abstract Syntax Notation (ASN.1, ISO 8825).

Byte-flipped machines, such as the Intel-equipped IBM PC, can nonchalantly communicate with Apple, DEC, and Sun computers. Every time a client stub is called, it places the parameters and appropriate external variables into a Request PDU and sends that PDU to the server. Then it waits for the server's Response PDU, updates the parameters and ex-

---

Barry Nance manages a 50-node NetWare LAN. He also authored Network Programming in C *(Que Publishing Corp., 1990) and is the editor of the IBM Exchange on BIX, where you can reach him as "barryn."*

ternal variables with the received values, and returns program control to the client.

The server code behaves as you would expect: It receives the Request PDU, unpacks the data, calls the appropriate subroutine, packs the results into the Response PDU, and sends the response to the client. You can encapsulate any data type in a PDU. Even an item referenced through a pointer is sent/received as an entity, and the pointer relationship is reestablished on the server. But you can't transfer the pointers themselves.

Floating-point numbers are another potential problem. An RPC converts floating-point numbers as best it can between different computers, but a less-precise server CPU can't preserve the exactness of the data across the call.

Be careful about passing large data structures or a lot of external variables when you are designing client/server systems. The data has to be sent between computers, and that takes time.

Depending on the complexity of the application, you can choose one of three basic server control procedure bindings. *Single binding* supports one client at a time; it denies other clients access to the server. *Multiple-client binding* also processes one request at a time but puts subsequent requests in a queue. *Multitasking* handles multiple client requests by establishing a separate thread for each. You would use single binding if you had multiple servers and wanted the client to do a round-robin search of servers until it found one that could handle a request. Not all RPC implementations support multitasking;

RPCS IN A NUTSHELL

```
/* Client module */
struct DATA_REC data_record;
main ()
    {
    gather_input ();
    calc_results(&data_record);
    }
```

Client stub
calc_results ();

Code generated by RPC compiler

LAN communications session created by RPC

Server stub

Code generated by RPC compiler

```
/* Server module (actual subroutine) */
calc_results (struct DATA_REC *data_record)
    {
    data_record->result = 5;
    }
```

The client module calls `calc_results()`*, a stub on the client machine that sends a copy of* `data_record` *to the server. Once the actual* `calc_results()` *routine, which resides on the server, has completed, it sends an updated copy of* `data_record` *back to the client.*

you need to use a server whose operating system understands multiple process threads.

To RPC or Not to RPC

It's technically possible to use RPCs to transform any application into a client/server system, but you wouldn't want to put small, fast-executing routines in a server. The time spent in communicating the data back and forth would overwhelm the application and cause severe degradation. Calculation-intensive or I/O-intensive routines are good candidates for server modules, assuming you have computers on your network that do a better job at such tasks.

It's possible to use your superfast 486 file server in a client/server role. NetWare 386 has a special provision for running custom-written code alongside the NetWare operating system. You can develop server routines as NetWare loadable modules. NetWare 386 lets you load and unload NLMs while the file server is active, and you can use NetWare's debugger to inspect the server module's behavior.

You write NLMs as you would any C program. However, you need the NetWare Compiler/386 (a repackaged version of Watcom 7.0), and you have to use the NLM library code supplied with NetWare Compiler/386 for the I/O and memory management aspects of the program.

For fun, I created an NLM version of the E-mail application from my book *Network Programming in C*. The Mail NLM is a server module that simply stores and routes mail messages; the client (workstation) code invokes the server routine `send_mail()` to dispatch a mail message.

Neither CPU-bound nor I/O-bound, the Mail module nonetheless has two advantages as a server subroutine. Because the Mail NLM is a unique NetWare object, I was able to give it the right to use a certain subdirectory on the file server and exclude other objects—the users—from accessing the subdirectory. This ensures mail privacy. Second, designing the mail module as a true "post office" makes for a cleaner architecture. The workstation never has to know how the mail is delivered; it simply puts it in the mailbox and lets the server module handle routing.

If you're interested in seeing my mail program code, you can contact me c/o BYTE or on BIX and I'll send it to you on disk.

Serious, mission-critical applications are excellent candidates for client/server distributed processing. I have found RPCs to be useful tools for automatically building the interface between clients and servers. Although I enjoy writing IPX/SPX communications code, I shudder to think of the effort it would take to create, by hand, each link between client and server modules in a large application. ■

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ASK BYTE

PostScript, Too

I am running an IBM XT clone with a Hewlett-Packard DeskJet printer. I want to be able to access soft fonts to supplement the one supplied with the original DeskJet. At best, I would like my printer to be able to interpret the PostScript command language, and at the very least I would like to be able to use normal HP soft fonts, without spending more than the $400 I originally paid for my printer.

Edward Hyer
Blakes, VA

You should be able to upgrade for less than $400. One way to do it is through software. PostScript interpreters will take the output from your applications and translate it into PostScript. This process will work on an IBM XT, but it will be very slow. If you can bear the slow speed, this would be your best answer. Adding expanded memory will speed it up some, but that adds extra cost. Check with vendors of PostScript interpreters, including LaserGo (9369 Carroll Park Dr., Suite A, San Diego, CA 92121, (619) 450-4600) and Atech Software (630 La Place Court, Suite 245, Carlsbad, CA 92008, (800) 748-5657 or (619) 438-6883), to make sure they work with the applications you use.

To use HP soft fonts, you will need additional RAM for your printer. Hewlett-Packard sells a 128K-byte RAM cartridge for about $125 and a 256K-byte cartridge for $175. How much RAM you need depends on how many fonts you plan to use in a single document. HP sells additional soft-font cartridges for between $75 and $95. Bitstream (215 First St., Cambridge, MA 02142, (617) 497-6222) also sells soft-font cartridges. For more information and pricing of specific cartridges, call HP printer support at (208) 323-2551. I think your best bet would be the RAM cartridge from HP. You'll get your output faster and should still stay within your budget.
—S. D.

Is This Bad?

My PC has a 20-megabyte hard disk drive. When I formatted it the first time, the format program found 200K bytes of bad sectors on the disk. Six months later, I reformatted the disk and found that the bad sectors now took up 600K bytes. How does this happen? How can I prevent this problem or recover from it?

Dat Dao Nguyen
Montreal, Quebec, Canada

The physical cause of your problem is not easy to nail down; bad sectors can arise from several sources, including head misalignment and particles of magnetic coating flaking off inside the disk drive. Either one could cause the number of bad sectors to grow over time, as you report.

First thing to do: Back up your drive. Then give it a new low-level format. If the number of bad tracks that your new low-level format reports is very large, conclude that your disk has suffered some kind of failure and needs to be sent to a repair shop or replaced.

You may also want to look into some disk utilities for backup and recovery. See "Just What the Hard Disk Doctor Ordered," January 1990, for more information on disk utilities.—S. A.

Returning Student

I am writing to you concerning a change I am contemplating. I have an old Commodore 64 home computer I was using in high school. I haven't used it in several years, but I'm planning on returning to college soon and am looking for a new computer to use at home for studies and communications purposes. I want one I can use to reach my college lab computer and to talk to friends I have around the country. Could you please give me some kind of direction as to what to get (e.g. base computer, hardware, software, and networks)? Because I have experience only in the BASIC language, I need a computer that is easy to learn on as well. Any help would be appreciated.

Mark Clarendon
Scottdale, GA

If you anticipate buying a computer for use in your studies, I suggest you contact the college you are planning to attend and find out what computers it recommends. Many colleges specify a particular type of machine (e.g., Macs or PCs) for use with the college's network. Often the college can sell the computers and software to students at a substantial discount.—S. W.

Action!

I am new to the programming environment and would like to make a fast-action boxing game for PCs with EGA or VGA video hardware. What is the best (i.e., the fastest) language for this?

Also, in your April 1989 issue, I found an article on the RenderMan interface. Is this a set of routines compatible with assembly language and C?

Lester Rich
Address unavailable

By "fastest" I assume you mean in regard to execution time, rather than development time. If so, assembly language is the ticket—you can't go much faster than well-written assembly language. Of course, given that you're new to programming, picking assembly language as your development tool could mean that you'll spend a great portion of your time learning what the different instructions mean. It might be best to select a high-level language to start out with—Pascal, C, or Modula-2—to develop the algorithms for your game. Then, as you become comfortable with programming and the direction your product is taking, you can convert speed-critical portions of your game to assembly language. To quote an adage I've seen often: "Get it working today; optimize it tomorrow."

RenderMan is actually an interchange standard developed by Pixar that allows output from modeling software to drive Pixar's rendering software. In simple terms, this means that if you want to display a three-dimensional scene on the computer monitor, you tell RenderMan what objects are in the scene, where they're located,

where the light sources are, what the viewing angle is, and so on, and RenderMan paints the picture complete with textures and highlights and shadows. RenderMan is written in C, so calling it from C is likely to be the easiest means of using RenderMan. (Other languages can call the RenderMan routines, provided they adhere to proper calling conventions.)

If you're seriously interested in RenderMan, I suggest that you scout the bookstores for a copy of RenderMan Companion *by Steve Upstill (Addison-Wesley, 1990). It's a good source of information.*—R. G.

Don't Panic

In your October 1990 issue there was a long review of different types of operating systems and WORM (write once, read many times) optical disk drives (see Computing at Chaos Manor: "A Lesson in Maintenance"). The author mentioned the term *panic disk* and strongly suggested that *everyone* should make one for his machine.

What is a panic disk and how does one make it?

Mark L. Woodward
Montara, CA

A panic disk is essentially a DOS boot disk that contains all the files (e.g., AUTOEXEC.BAT, CONFIG.SYS, device drivers, and other software) that allow you to restart your computer from the floppy disk drive.

Occasionally, when you install new software or operating systems, the new software may conflict with existing software on your hard disk drive or with the computer itself, causing the computer to "lock up" and refuse to respond to anything but a power-off/power-on reset. The panic disk lets you reboot the computer, gain access to your files on your hard disk drive, and make any necessary changes. A panic disk is good insurance should the files in your root directory become damaged or erased.—S. W.

Disk List

I am involved in computer repair and maintenance of field equipment for the State of Texas. The computers vary in operating system and manufacturer. Hard disk drives are among the most frequent items that require maintenance. However, general drive specifications are not available, making diagnostics, interfacing, and/or formatting difficult if not impossible. A list of the drives you have knowledge of and their general specifications (i.e., model number, interface type, formatted capacity, number of cylinders, number of data heads, write precomp, and reduced write current) would be greatly appreciated.

Randolf B. Beck
Austin, TX

BYTE does not maintain lists of hard disk drive specifications except for our own maintenance and repair needs. One good source of information is the Western Digital BBS: (714) 756-8176, 1200 bps, no parity, 8 data bits, 1 stop bit, full-duplex. The BBS has a list of most brands of hard disk drives and their specifications.—S. W.

Two Floppies Aren't Enough

The SCSI interface is rapidly gaining popularity for many peripherals, such as hard and floppy disk drives, tape backup units, and other devices. Most PCs can control only two floppy disk drives, even though it is convenient to use more, especially for copying or backing up an entire disk in various formats. The standard floppy disk drives, with standard interfaces, are now relatively inexpensive. It would be very useful to have an adapter card that would allow one to connect several standard floppy disk drives (externally mounted, if necessary) in a daisy chain to the SCSI bus. Do you know of any company that sells such a card, one that would connect the SCSI bus from the host adapter to a chain of standard floppy disk drives? I have contacted several companies that build SCSI host adapters, but they do not have one. If it is not commercially available, do you know of a published design that I could build?

Charles F. Hempstead
Andover, MA

SCSI interfaces, because of their relatively high cost, are usually reserved for high-speed devices that manage large amounts of storage. Floppy disk drives seem to work well enough with the standard floppy interface, so maybe that's why no one makes a SCSI floppy disk drive. If you'd settle for a standard PC floppy disk drive interface card that handles four drives, I've got two of them for you: MicroSolutions (132 West Lincoln Hwy., DeKalb, IL 60115, (815) 756-3411) makes the Compaticard IV, and JDR Microdevices (2233 Branham Lane, San Jose, CA 95124, (800) 538-5000) carries the MCT-FDC-HD4 4 Floppy Card. Both products support four floppy disk drives, in any combination of 3½-inch, 5¼-inch, and high and low density. Unless you specifically need SCSI support, one of these cards should do the trick.—H. E.

Organ Transplant

I subscribe to your magazine regularly. Most of the time it is somewhat over my head, but I enjoy reading it. Now I have a question. I have an "old" computer, a Standard (now CompuAdd) XT, and an EGA monitor, a mouse, and a 20-megabyte hard disk drive. I need to upgrade my system to a 386. Can I buy a "stripped-down" system (i.e., one with no hard disk drive or monitor) and put my old components in the new computer?

Anthony Grieco
Gadsden, AL

You can certainly recycle some of the components. The monitor, video board, mouse, and hard disk drive can all be used in a 386 system. You should also be able to reuse any serial/parallel port boards, but if any of the cards has a built-in clock circuit, the clock must be disabled, because it would conflict with the clock circuit on your new motherboard.

You will have to invest in a new floppy/hard disk drive controller card. I would also suggest that you obtain a larger hard disk drive of at least 40 MB. An older 20-MB hard disk drive is too small and slow for serious use with a 386 system.—S. W. ■

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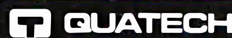
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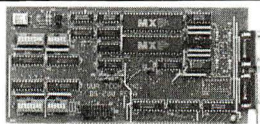


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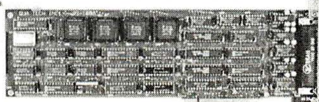
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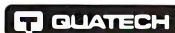
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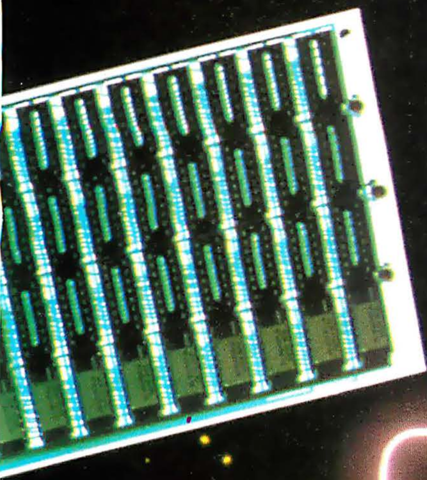


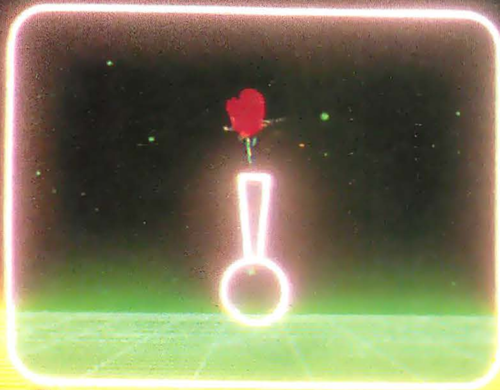
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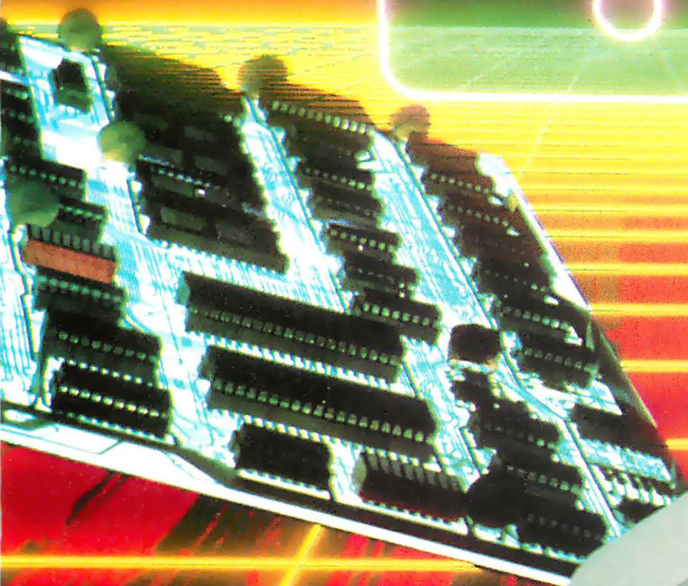
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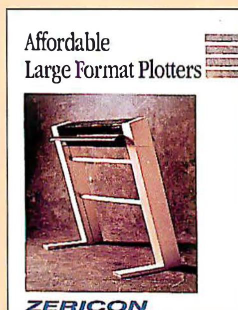


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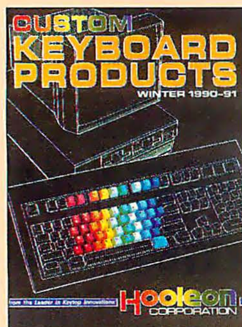
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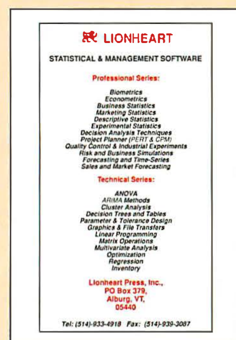
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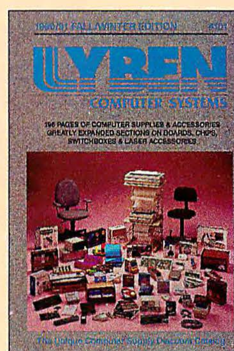
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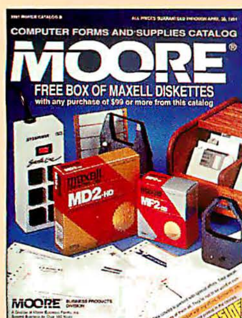
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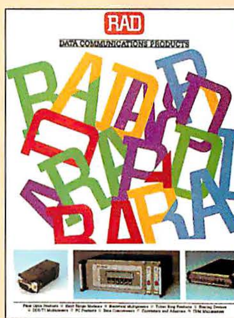
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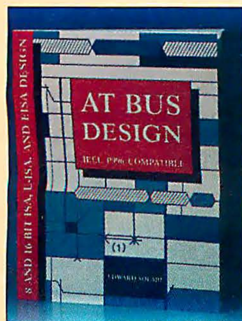
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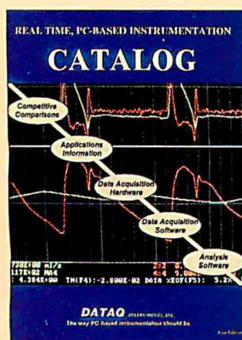
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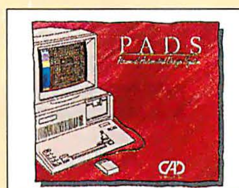


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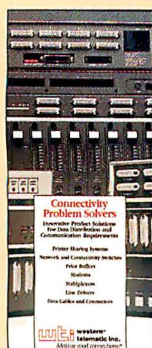
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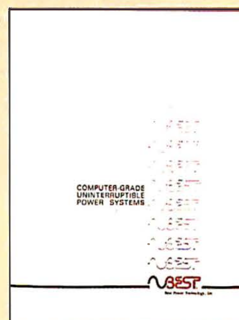
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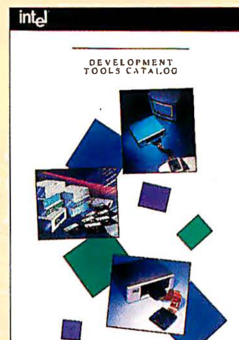
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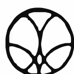
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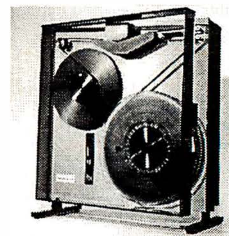


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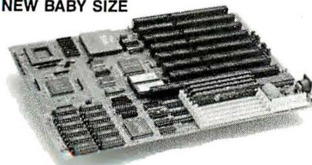
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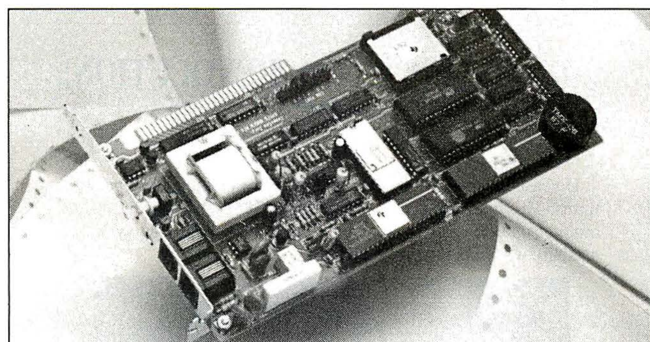
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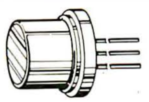
COLLIMATOR PEN
(INFRA-RED)



- Output: 2.5 mW (max.)
- Current: 90-150 mA
- Operating Voltage: 2.2-2.5V
- Wavelength: 820nm
- Collimation: .18mrad (typ.)
- Size: 11mm diameter

STOCK #	PRICE
SB1052	$39.99

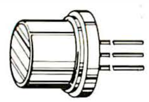
LASER DIODE
(INFRA-RED)



- Output: 10 mW (max.)
- Current: 90-150 mA
- Operating Voltage: 2.2-2.5V
- Wavelength: 820nm

STOCK #	PRICE
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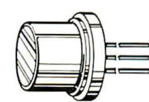
LASER DIODE
(VISIBLE-RED)



- Output: 5 mW (max.)
- Current: 65-100 mA
- Operating Voltage: 1.75-2.2V
- Wavelength: 780nm

STOCK #	PRICE
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LASER DIODE
(VISIBLE-RED)



- Output: 4 mW (max.)
- Current: 20 mA
- Operating Voltage: 2.2-3.0V
- Wavelength: 665nm

STOCK #	PRICE
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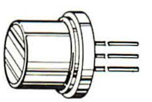
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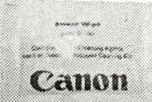
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(VISIBLE-RED)



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- Current: 85-100 mA
- Operating Voltage: 2.3-3.0V
- Wavelength: 670nm

STOCK #	PRICE
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2708	6.49	6.17	5.55	TMS2564	5.79	5.50	4.95
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2732	4.19	3.98	3.58	27C128	4.79	4.55	4.09
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4164-120	1.69	1.61	1.55	41256-120	1.89	1.80	1.63
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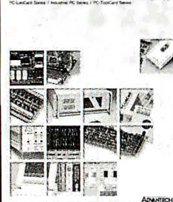
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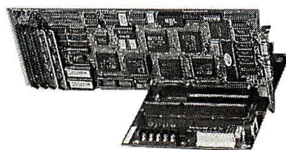
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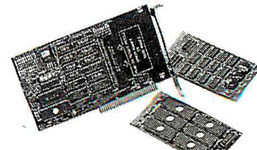
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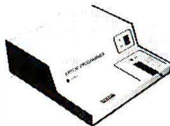
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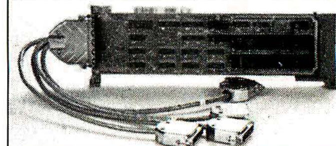


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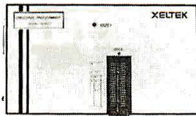
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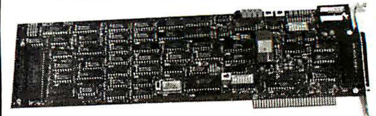
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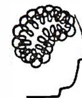
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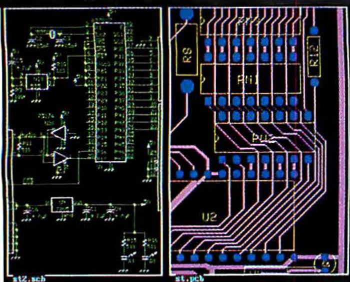
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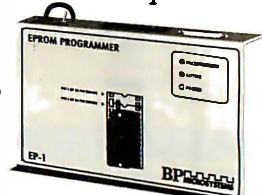
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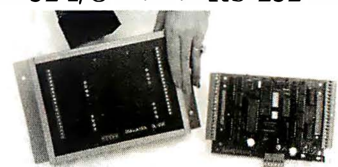
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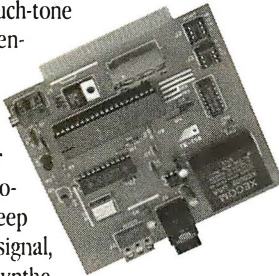
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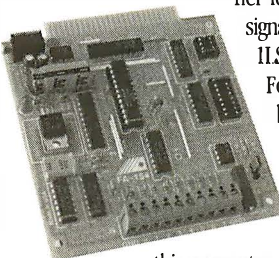
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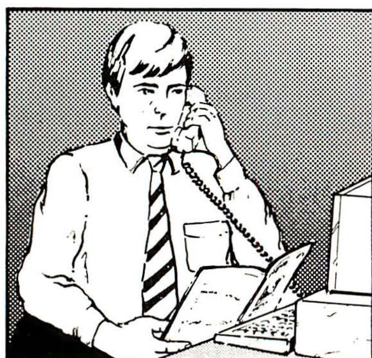


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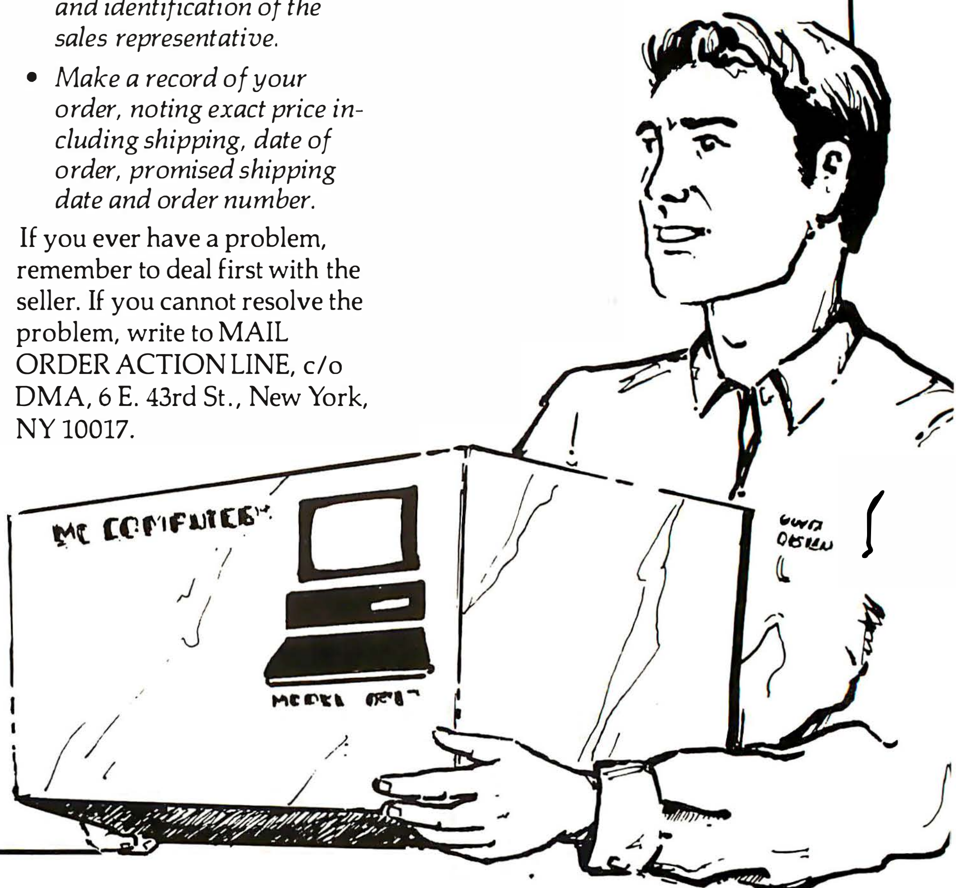
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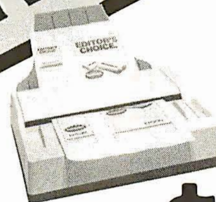
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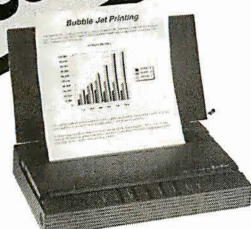


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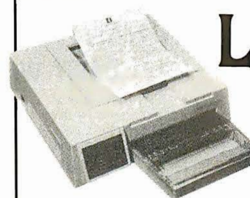
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	4MB Module	118690-001	448.00
DESKPRD 386/16	1MB Board	108069-001	299.00
	2MB Board	108069 W/71	348.00
	1MB Kit	108071-001	138.00
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	4MB Kit	108072-001	318.00
DESKPRO 386s	1MB Board	113633-001	198.00
	4MB Board	113634-001	448.00
	1MB Module	113646-001	104.00
	4MB Module	112534-001	258.00
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	4MB Module	113132-001	238.00
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DESKPRO 386/33, 486/25 SYSTEMPRO	2MB Module	115144-001	169.00
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PORTABLE III	512K Kit	107331-001	89.00
	INTFC BD	107808-001	99.00
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PORTABLE T1200xe	2MB BD	PC13-PA8306U	178.00
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PORTABLE T3100e	2MB Kit	1PC9-PA8341U	158.00
PORTABLE T3100SX	2MB BD	PC15-PA8308U	158.00
	4MB BD	PC15-PA8310U	458.00
PORTABLE T3200	3MB BD	PC6-PA7137U	298.00
PORTABLE T3200SX	2MB Kit	PC12-PA8307U	158.00
	4MB Kit	PC12-PA8309U	458.00
PORTABLE T5100	2MB BD	PC7-PA8301U	178.00
PORTABLE T5200	2MB Kit	PC10-PA8304U	168.00
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	2MB Module	ZA3800MG	189.00
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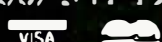
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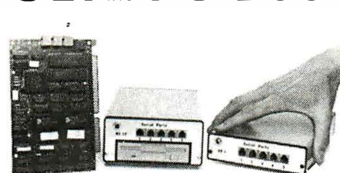
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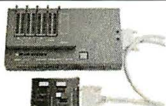
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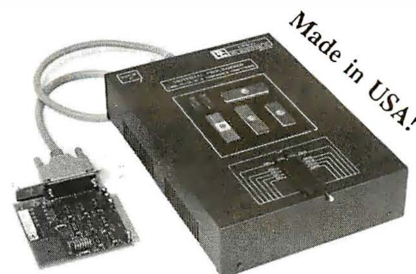
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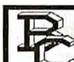
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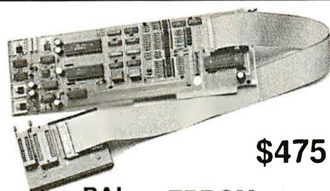
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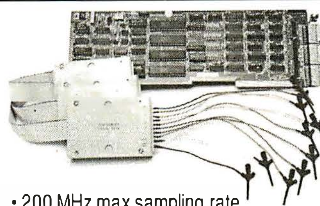
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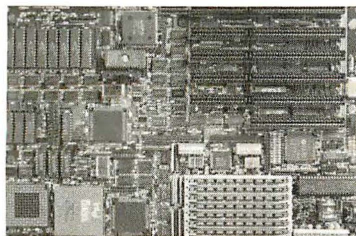
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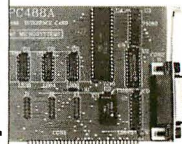


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- Digital I/O: 16 Input/16 Output channels; All I/Os TTL compatible.
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Index of companies covered in articles, columns, or news stories in this issue
Each reference is to the first page of the article or section in which the company name appears

Company, Page # Inquiry #

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INDEX TO ADVERTISERS BY PRODUCT CATEGORY

Inquiry No. — Page No.

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Just fax this page to 1-413-637-4343. Save time because your request for information will be processed *immediately*.

1 Circle the numbers below which correspond to the numbers assigned to advertisers and products that interest you.

2 Check off the answers to questions "A" through "E".

3 Print your name, address, and fax number clearly on the form.

4 Remove this page or copy this page clearly and fax it to the number above.

Fill out this coupon carefully. PLEASE PRINT.

Name

Title

Company

Address

City

State/Province Zip

Country

( ) Phone Number

( ) Fax Number

A. What is your primary job function/principal area of responsibility? (Check one.)

1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?

7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

10 ☐ Yes 11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)

12 ☐ PC/MS-DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?

18 ☐ 1-25
19 ☐ 26-50
20 ☐ 51-99
21 ☐ 100 or more

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2 Check all the appropriate answers to questions "A" through "E".

3 Print your name and address and mail.

Fill out this coupon carefully. PLEASE PRINT.

Name

Title

( ) Phone ( ) Fax

Company

Address

City State Zip

A. What is your primary job function/principal area of responsibility? (Check one.)
1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?
7 ☐ Senior-level 9 ☐ Professional
8 ☐ Middle-level

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?
10 ☐ Yes 11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)
12 ☐ PC/MS-DOS 15 ☐ UNIX
13 ☐ DOS + Windows 16 ☐ MacOS
14 ☐ OS/2 17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?
18 ☐ 1-25 20 ☐ 51-99
19 ☐ 26-50 21 ☐ 100 or more

☐ *Please send me one year of BYTE Magazine for $24.95 and bill me. Offer valid in U.S. and possessions only.*

MARCH
IRND009

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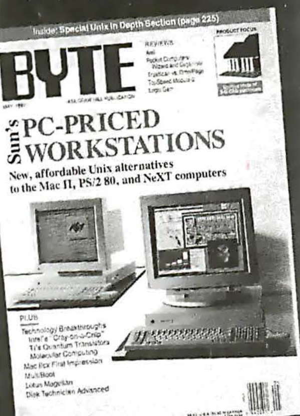
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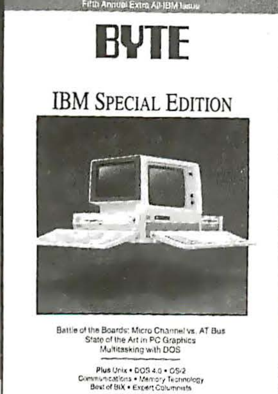
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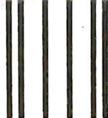
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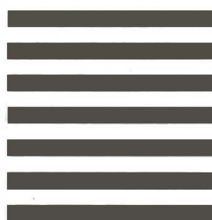
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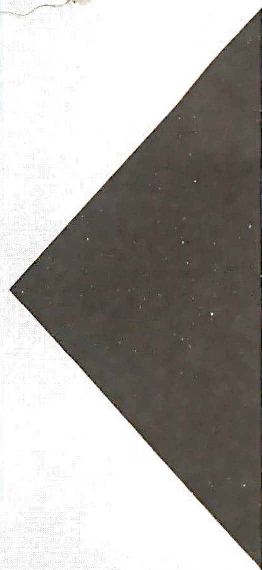
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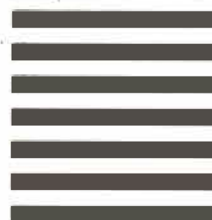
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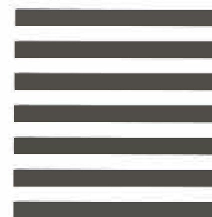
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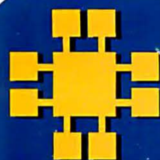


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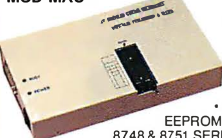
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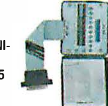
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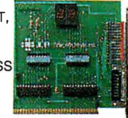


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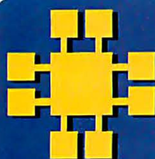
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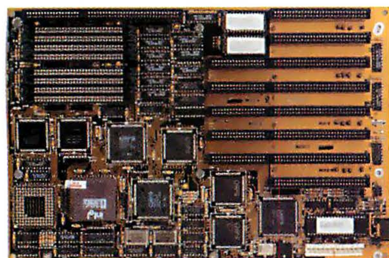
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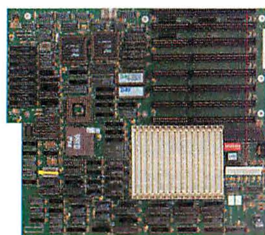
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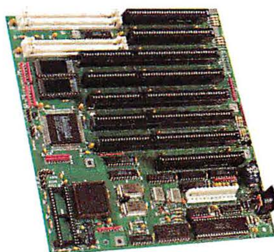
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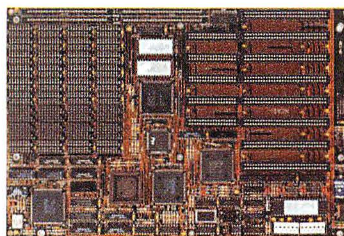


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continued from page 314

Listing 2: *LZW compression/expansion pseudocode. All structure references are simplified for readability. Unless explicitly noted, structures are elements of the* `Table` *array. For example,* `tableoffset.char` *should properly read* `Table[tableoffset].char`.

```
PROCEDURE LZW Compress
next_code <- MAXCHAR+1
numbits <- MINBITS                    // bits to represent a char + 1
basecode <- (next char from buffer)// read in a character
WHILE (input buffer not empty)
   char <- (next char from buffer) // read in another character
   IF (lookup(char, basecode, location)=FOUND)
                                      // this combination in the table
      basecode<-location.code         // update the base code
CONTINUE                              // get another character

// found a code that is not in the table
   outcode (basecode, numbits)   // send the last complete code
   add_code(char, basecode, next_code, location)
                                 // add basecode+char to table
   IF (table full)
      clear(codelist)            // clear some entries and put
                                 // their codes in the list of
                                 // available codes
   IF (table has been filled)
                                // get another code from the list
      next_code <- next code from codelist
   ELSE
      next_code++                  // or just use the next code
      IF (log2 (next_code) > numbits)// increase the bit size?
         numbits++
   basecode <- char                // start of next string
CONTINUE
outcode (basecode, numbits)

PROCEDURE LZW Expand
next_code <- MAXCHAR+1
numbits <- MINBITS               // bits to represent a char + 1
code <- incode (buffer, numbits) // read a variable-length code
write code to output               // write out this character
lastcode <- code                   // start with this character
WHILE (input buffer not empty)
   code <- incode (buffer, numbits)// read another character
   IF (code not in table)          // is this the special case?
//  this is the special case handler for codes not in the table
      outstring(lastcode)        // send out the last string again
      write lastchar to output   // and a duplicate first char
   ELSE                          // the normal case
      outstring(code)            // send the string for this code
                                 // get the new last char
   lastchar <- (first char from output string)
                                 // add a new table entry
   add_code(lastchar, lastcode, next_code)
   lastcode <- code
   IF (table full)
      clear(codelist)            // clear some entries and put
                                 // their codes in the list of
                                 // available codes
   IF (table has been filled)
                                // get another code from the list
      next_code <- (next code from codelist)
   ELSE
      next_code++                  // or just use the next code
      IF (log2 (next_code) > numbits) // increase the bit size?
         numbits++
CONTINUE
```

```
// LZW compression support routines

// Note: expansion string table is indexed, while compression table
// is hashed by char and basecode. Therefore, add_code and clear
// shown here are appropriate for the compressor.
// Actual add_code and clear used by expander are not
// as complex.

PROCEDURE lookup (char, basecode, tableoffset)
                                          // find the table entry (table
                                          // offset is passed by reference)
tableoffset <- hashfunction (char, basecode)
DO FOREVER
   IF (tableoffset is a filled table entry)
      IF( tableoffset.char = char AND
tableoffset.basecode=basecode)
        RETURN FOUND
      ELSE
        tableoffset <- rehash (char, basecode)
   ELSE
      RETURN NOT_FOUND
CONTINUE

PROCEDURE add_code (char, basecode, code, tableoffset)
tableoffset.code <- code          // update the fields at
tableoffset.char <- char          // location in the table
tableoffset.basecode <- basecode
x_index[code] <- tableoffset  // update the cross-reference table

PROCEDURE clear (codelist)           // clear part of the table
STATIC bits_in_oldest <- MINBITS  // keep track of oldest leaves
FOR (entry<-0) TO (entry=TABLESIZE)
   mark x_index[entry] as a leaf // mark every cross-index entry
FOR (entry<-0) TO (entry=TABLESIZE)
   notleaf <- x_index[entry].basecode
   unmark x_index[notleaf]           // unmark those used as other
                                     // node's basecodes
FOR (each entry represented by bits_in_oldest bits)
   IF x_index[entry] is marked as a leaf
                                    // erase the oldest leaves and
      add entry to available code list
      mark table entry as empty      // recycle their codes
bits_in_oldest++                     // update oldest leaves
IF bits_in_oldest > MAXBITS
   bits_in_oldest <- MINBITS         // wraparound

PROCEDURE outstring(code)
IF (code is a literal character)
   write code to output buffer
   RETURN
WHILE (code is not a literal character)
   push code.char                // push the character for this node
   code<-code.basecode              // jump to the previous location
push code                       // save the last code (the literal)
pop string to output buffer          // pop the string we've built
```

Expanding LZW

Like the dynamic Huffman algorithm described earlier, LZW coding does not require you to pass a decoding table to the expander along with the compressed data. The LZW expander can build its own table from nothing but the codes in the compressed data.

The expansion program starts with a table, just like the compressor's, with only literal data defined. It begins by reading the first character from the compressed input. It sends this character to the output, but otherwise it just holds onto the character to form the basis for the next string.

For each code after the first that the expander reads, it generates a string and makes an update to the string table. The expander first uses the string table to translate the code value to an output string. For nonliteral codes, it backtracks through the code/character combinations of the string table, pushing characters onto a stack as it goes. When the expander reaches a literal code, it pops the stack to produce the output string.

In addition, each code after the first one causes a table update. For the second code, the expander adds a code made up of the first code, plus the first character in the string described by the second code. For each code thereafter, the expander adds the last code translated plus the first character in the current string to the table. The resulting table is an exact duplicate of the compression table, which changes with each code received.

Welch describes a special-case situation that complicates the expansion algorithm slightly. A certain type of string can cause the compressor to output a code before the expander has it in its table. This situation occurs when strings of the form *XandXandX* appear and the string *Xand* is already in the table. In this case, the compressor will send the code for *Xand* (because it already knows that string) and then add *XandX* to the table. It will then start with the middle *X*, find the next group of characters that it knows is *XandX*, and send the code for *XandX* before the expander knows its meaning.

You can handle this special case by adding a few lines of code in the expander program. If the expander receives a code that it doesn't recognize, it knows that it has encountered this singular case. In the above example, the expander receives the code for *Xand* and then an unknown code. It writes out the last translated code again (*Xand*) and then the first character from that code (*X*). It then adds a combination of these characters (*XandX*) to the table, which puts it back in sync with the compressor.

Enhanced LZW

Two enhancements to the basic LZW algorithm, variable-length codes and table clearing, make for a more flexible and robust compressor.

With fixed-length output codes, you must decide up front how many bits to use for encoding the compressed data. If you use a small number of bits, the table fills quickly and compression drops off rapidly. If you use a large number of bits, the overhead for each code that you do not successfully compress is enormous.

The sample code (see listing 2) uses variable-length codes to work around this problem. Initially, it uses 9-bit codes. When the compressor runs out of 9-bit codes, it switches to 10 bits, and on up through 13. It then uses 13-bit codes for the rest of the output.

Listing 2 shows that the compressor increases the bit length when the next code to add to the table requires more bits than allowed by the current bit length. This is not the next code to output; the next code to output will be the code that matches the next part of the input. However, because the expander and compressor use this same method for determining which code in the table to use next, they make the switch in bit sizes simultaneously.

Even with a 13-bit table, the LZW compressor will eventually run out of string locations. One way to handle this problem is to stop adding entries and use the strings in the table to compress the rest of the input. This will result in poor compression if the type of data changes from one part of the input to another.

You could also clear the table when it becomes full and start building the table again with the new data. Although this method makes the compressor more flexible than the do-nothing approach, it will also result in reduced compression while the table is mostly empty.

Listing 2 uses a partial-clearing approach to freshen the string table when it becomes full. The code clears only some of the older strings in the table when it becomes necessary.

Because the string data is stored as base code/character combinations, you can't merely keep track of the least frequently or least recently used strings in the table and later eliminate them when the table is full. You can eliminate only the nodes that are not used by other codes as base codes (the leaves).

It makes sense to keep track of the age of each leaf by the number of bits required to describe its code. When the table fills, you can remove all the 9-bit leaves and reuse their codes. When the table fills again, you can recycle the 10-bit leaf codes. Once the 13-bit leaves have been reused, you can go back to removing 9-bit leaves and continue in this manner indefinitely.

To determine which node is a leaf and which is not, the table-clearing routine takes a relatively brute force approach. First, it marks all the nodes as leaves. It then goes through the table, looking at base codes. Each base code is the code of a node that is not a leaf, so it unmarks the node that corresponds to that code.

Unfortunately, there is one more complication in finding the leaves to eliminate. The compressor stores its string table in a hashed array because it must try to find codes in the table knowing only their base codes and appended characters. For the clearing routine to find codes given the code itself, you can use a cross-index table that maps sorted codes to table locations. While this uses up a good chunk of memory (16K bytes for 16-bit pointers and a 13-bit table), it provides for quick table access by either the code or contents.

The Sample Code

To try out these two compression algorithms, I wrote two assembly routines designed to be called from programs written in C. (The full text of these routines is available in electronic format. See page 5 for details.) Both take an input and output file handle, compressing data from the input file and writing it to the output file.

Even if you don't need to write your own compressor, a little background in data compression is useful. Although data compression may appear complex and fraught with danger, it's actually valuable and reliable, as you can see. ■

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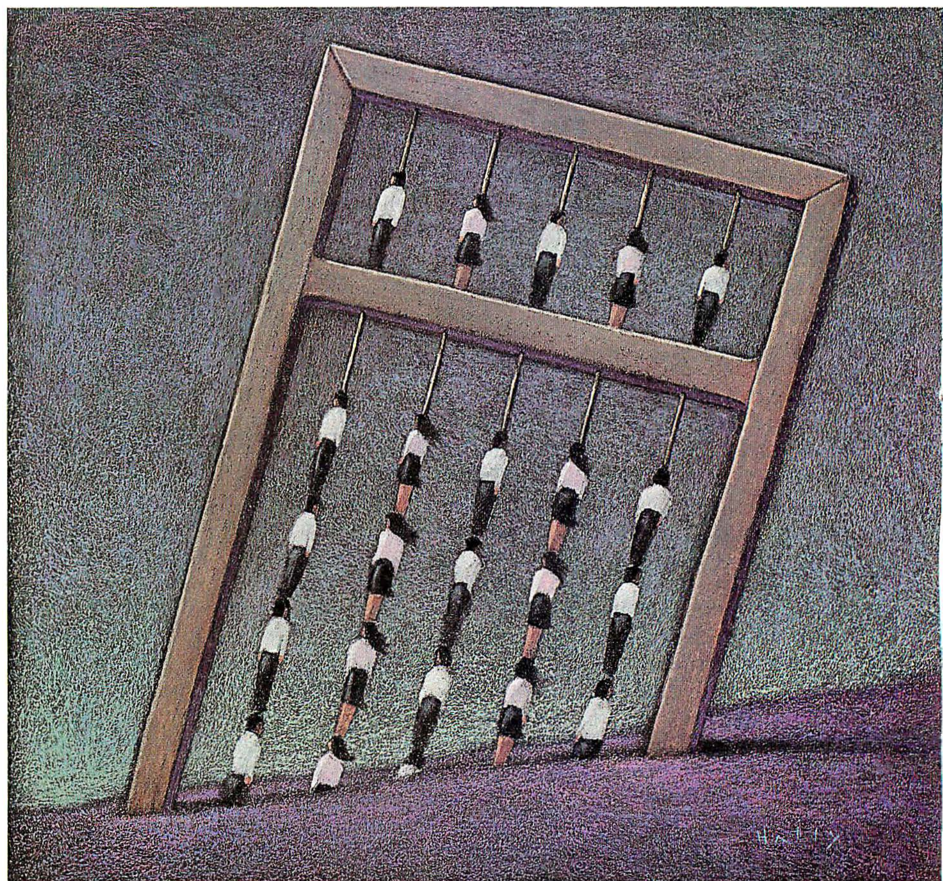
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HUGH KENNER

More Mathematical People

The successor to a 1985 literary gem is just as delightful as the original



Bill Gosper has "no patience at all" with "these damned PC's" (they're too small). Nor patience either with physicists, who have "the most abysmal taste in programming environments": They fancy the software equivalent "of a junk-strewn lab with plug boards, bare wires and alligator clips." No, Bill Gosper ("a cycle junkie") lusts after clean algorithms; also, the biggest and fastest supercomputer there is, so long as it's well out of reach of physics types.

Bill Gosper is talking to Donald J. Albers, the man whose idea that the talk of math whizzes might be both instructive and *fun* led to the book *Mathematical People*, a golden oldie of 1985. We're now sampling its successor, *More Mathematical People* (Harcourt Brace Jovanovich, 1990, $29.95). The 18 interviews were conducted by Albers, Gerald L. Alexanderson, and Constance Reid. Their copiously illustrated book is an end-to-end delight.

And Bill Gosper? Approximately, a man with a passion for continued fractions, which he likens to chopsticks: Awkward at first, but once used to them, we're pitying "those poor Europeans who must grab their salad greens with a sour-tasting, bent metal object with no moving parts." He long ago found he disliked typing 3.14 when he meant pi, "because no matter where I stopped, there I was introducing an error at a place where there was no error." For "the decimal expansion of an irrational number does *not* repeat"—it burbles as if at random—whereas Gosper's continued-fraction version of pi will chirp "2" forever once it's past a mere 17 terms. If you can't get excited by that, well, you're not Bill Gosper. Nor have you his fascination with potentially *exact* results.

In 1985, Gosper "briefly captured the pi-digit calculation record." Not that he coveted all those random-seeming decimal digits. "Who wants a number that hasn't finished describing itself?" But "people are willing to tolerate an error in a number, just for the convenience of not having a string of digits hanging off it."

Utility is not the point. If we're calculating the circumference of the earth, the difference between a 5-place pi and a 6-place is about half an inch. So what's nagging Gosper in the zone of million-place pi is something purely aesthetic. A cliché, yes: math, an aesthetic domain. But a cliché into which the talk in *More Mathematical People* breathes welcome life. In high school, Gosper was a "nerd" who got good grades, and what pointed him toward MIT was the thrill of all those computers. There was even a PDP-1 they'd let students use, unsupervised! "That's where it all started." And that's one kind of aestheticism: a come-hither from sleek unknown potential.

And here is Fred Mosteller remembering a sophomore ecstasy. Probability that the sum of three dice will yield 10? "We all got the answer by counting on our fingers." But what about six dice, and the likelihood of getting 18? Wouldn't we still be home counting? The boy who had the wit to ask that question had a teacher with the wit to send in someone who knew.

"So we went to his office, and he showed me a generating function. It was the most marvelous thing I had ever seen in

mathematics. . . . It was a total retranslation of the meaning of numbers. I really thanked him." (Up until that time, Mosteller had thought that the use of such things was "just to create homework problems for innocent students.")

And Bill Thurston, remembering an abacus from when he was tiny: "I was just so amazed that ten of these beads made one of these, and ten of these—you could get up to really huge numbers." He also remembers, from later, "Martin Gardner's column in *Scientific American*." (So do other interviewees. There's a thesis awaiting, some day, about Gardner's good-genie pressure on modern math. Thus, his column was where the game of Life was first published, and that game is Bill Gosper's *other* passion: "So many existence theorems for behavior." If you remember Life's "Glider Gun," well, it was Gosper, two decades ago, who felt he was "approaching a demi-god" when he worked up the nerve to report that to Gardner. He and some pals had discovered it while they were at MIT.)

Back to Thurston, though, who states the Immersion Theorem as technically as you please—"The space of immersions of a manifold in another manifold is homotopically equivalent to the space of bundle injections from the tangent space of the first manifold to the tangent bundle of the second"—and then lets on that he's helping with a computer program to make *that* vivid via movies. Then pros might get turned on: "Most of them have never heard of the Immersion Theorem." But the real target audience? High school math students, on whom the film could perhaps have such an effect as the abacus had on Thurston. It's been proved that immergence can help you turn a sphere inside out, and that will be something to see.

A large number of mathematicians swear up and down that they never go near such things as computers.

"I always try to put pictures in my papers"—as most mathematicians, he could have pointed out, don't. Most mathematicians will also swear up and down that by golly they never go near such things as computers. Thurston thinks they could do "a little catching up on that subject." He also hints that more than a few of them may be closet computerists who stay in the closet for fear of loss of face.

Here's the moment for a brief detour via N. David Mermin's *Boojums All the Way Through* (Cambridge University Press, 1990, $49.50), a book I chanced to pick up in Paris last summer, the day I also picked up an illuminating fact: The 40-odd pages of computer-related listings in the Paris Yellow Pages are all gathered under one heading, "Informatique."

Informatique—information—that's Mermin's bag. He's made a career, running parallel with his career as theoretical physicist at Cornell, out of the simple perception that "physics, limply expressed, is less fun." Scientists, he reminds us, wrote beautifully through the nineteenth century into the early twentieth. (A phrase the young James Joyce treasured—"a day of dappled seaborne clouds"—was something he'd found in a book about geology.) Thereafter, the blight; and reading scientific papers became "an act of tedious drudgery."

A boojum, as we learn from Lewis Carroll's poem "The Hunting of the Snark," was a singular variety of snark that caused whoever met it to "softly and suddenly vanish away." That was just the word, Mermin realized, for a mathematical singularity—never mind the details—that caused a supercurrent to vanish from liquid helium-3 at superlow temperatures. The title essay of his book recounts, hilariously, his long campaign to get boojum enshrined in the technical literature. You'd not want a part in any bureaucracy our man has decided to outflank. By February 1988, boojum had appeared "in the instrumental plural (*budzhumami*) in the *title*" of something in a Soviet journal. Now that's infiltration. See the book for a play-by-play of the long campaign.

See the book, too, for such gems as "What's Wrong with This Library?," which commences from a 1961 perception that, by extrapolation from its then rate of growth, *Physical Review* would soon be filling bookshelves at a speed exceeding that of light. By now, never mind *Physical Review*, "keeping up with everything is driving the libraries into bankruptcy." So "the default response to a request to be on the editorial board of a new publication should be an emphatic no, accompanied by a reasoned statement of why the journal should not be started at all." Also, "we should all think twice before writing yet another article." Important to draw back from "that dreaded point beyond which no information is conveyed."

What's conveyed in *More Mathematical People*—I'm back to that—is chiefly zest; if zest is not a mathematical truth, it's a truth about where math comes from. Here's Cathleen S. Morawetz (the *S* stands for Synge, and she's a grandniece of J. M. Synge, the Irish playwright). How come she was working in magnetohydrodynamics? She remembers a teaser who'd hint that it "wasn't very feminine." Her reply: "Most women—in fact, most people—don't have the broad education that I got in Toronto. I learned a lot of physics. I took circuit theory as an undergraduate and a little bit of elasticity and optics. . . ."

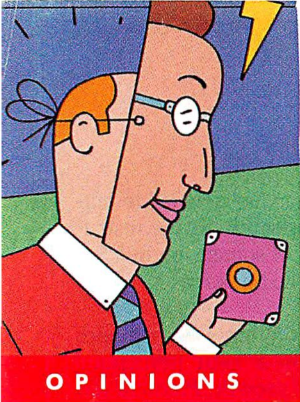
What she doesn't mention is that her father—the playwright's nephew—chaired the University of Toronto math department in those days; he later took charge of the Institute of Advanced Study in Dublin, where Schrödinger was a participant. A relative, R. L. M. Synge, was 1952's chemistry Nobelist. So some things run in the blood, never mind what's "feminine." I remember her as Cat Synge. We graduated from Toronto the same year (1945), she in "M & P" (math and physics), I in English language and literature. I endorse everything she says about Toronto education. Those curricula were long since gutted by egalitarian fury. We're scanning intricate webs; there are many ways for mathematicians (or writers) to find out that that's what they are.

The great John Millington Synge, by the way, seems to have been the black sheep of the family: neither a scientist nor a clergyman. Had he lived past 37 (when he'd written a mere six plays), he might have been coequal of Shakespeare, whose first six plays barely matter. Destiny, vocation, finding out what you're meant to do: *More Mathematical People* is never far from such themes.

Cat has appended a note to her interview: "I find I may have emphasized the need to escape from the devils of mathematics to embark on the pleasures of the real world. But it works both ways, and sometimes the devils of the real world drive one into the pleasures of studying mathematics." ■

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STOP BIT

OPINIONS

TOM YAGER

OPEN SEASON ON UNIX?

Sometime during the last 10 years, the word *open* crept into the homespun lexicon of computerdom. It was born when users began installing cards in their own computers and has decomposed to its present, meaningless, hype-laden existence. This helpless word's demise is thanks partly to the rise in popularity of Unix, something else that seems destined to lose its meaning and worth.

As close as I can figure, "open" is supposed to revolve around a voluntary cooperation among competitive concerns. If you believe the headlines, every Unix computer vendor in the world has agreed that users deserve to expect a certain amount of predictability when moving from one vendor's system to another.

Popular versions of Unix have a long way to go before they are truly open systems

This is largely a user-interface issue, and "standards" like Windows and Presentation Manager fix things for users of DOS and OS/2. That's thanks, of course, to Microsoft, which is powerful enough to create standards as if with a magic wand. Formerly, I didn't buy into this kind of "proprietary openness" (I hope Microsoft doesn't start using that phrase in its ads), but watching the purveyors of *true* openness flail around has left me rethinking my position.

My first disappointment was with the mythical beast that's called the 386 Unix Binary Compatibility Standard (BCS). Mythical, because it fails to cover networked and graphical applications, two areas that give Unix its appeal to new users. But most software vendors don't want to package a different version of an application for each of the several flavors of PC Unix, so they are choosing to port to only a single Unix or just forgetting the whole thing. I don't blame the software companies; until the bickering dies down and the binary standard becomes more than a skeleton, it's best to choose a seat and stay put.

To their credit, I did get belated press releases from both The Santa Cruz Operation and Interactive Systems, stating that they (along with AT&T and others) would be extending the System V release 3.2 BCS to include things like networking and X Window System. But I got two *separate* press releases, one from each company, and each failed to so much as mention the name of the other. That filled me with confidence. But if there is to be a proper binary standard, it better not take too long to congeal; workstation prices are dropping so quickly that there may be little advantage to PC Unix in the near future.

So, I got to thinking that maybe the best kind of openness is Microsoft's, the kind controlled by one company. In the Unix domain, I figured that Sun Microsystems was a good example of this, with its licensing of SPARC hardware and software. After all, more than a dozen companies have signed up to crank out Sparcstation clones, and they'll all be running SunOS 4.1. How forward-thinking, I thought, for a company to license not only its CPU design, but its latest operating system as well.

Once again, openness has its price. It seems that Sun plans to hinder its licensees by keeping certain "value-added" parts of the operating system to itself—like the `extract-unbundled` utility, used to install virtually every third-party SPARC application, and programming support for the audio I/O port.

The list of holes blown in licensed versions of SunOS goes on. This confuses me, because Sun is passing up a major opportunity to make money. Since most clones will be sharing networks with real Sun machines, those missing parts of SunOS will be just a network packet away. Users will copy the missing software, and each transfer will be money out of Sun's pocket.

Sun could broaden its licensing policy and fill the gaps, and SunOS could then be SunOS, regardless of the label on the system. Would that be giving too much away? Hardly. Sun has the higher-performance Sparcstation 2 all to itself.

Sun needs to tread carefully in open territory; users expect licensed SunOS to behave like Sun's own, and that means no surprises. Sun should also dump SunView, the unattractive and cumbersome proprietary windowing system shipped standard with licensed SunOS, and replace it with OpenWindows 2.0.

While Unix is winning converts far and wide for its versatility, the companies in the best position to push it over the edge toward *real* success are still straining at gnats. Perhaps the recession will scare a few players into smarter thinking. ■

Tom Yager is a technical editor for BYTE. He can be reached on BIX as "tyager."

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